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Society for the Encouragement of Arts, Manufactures, and Commerce,

JOHN-STREET, ADELPHI, LONDON, W.C.

EXAMINATION PAPERS

SET AT THE

EXAMINATIONS OF THE SOCIETY OF ARTS,

HELD IN APRIL, 1866.

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OF THE

Society for the Encouragement of Arts, Manufactures, & Commerce,

FOR THE 113TH SESSION, 1866-7.

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EXAMINATION PAPERS

SET AT

THE EXAMINATIONS OF THE SOCIETY OF ARTS, HELD IN APRIL, 1866.

ARITHMETIC.

THREE HOURS ALLOWED.

- Find by practice the value of 319 cwt. 3 qrs. 16 lbs. at £2 12s. 6d. per cwt.
- What will be the purchase money of an estate containing 191 ac. 3 ro. 37 po. at £47 17s. 7d. an acre?
- If I gain 3s. 4½d. of profit on every guinea of outlay, what amount of outlay will gain £2 16s. 3d.?
- If the carriage of 6 cwt. 2 qrs. for 124 miles cost £3 4s. 8d., what weight should be carried 93 miles for £3 0s. 7½d.?
- After I had gone $\frac{3}{8}$ of $\frac{1}{2}$ of twice my journey I had 10½ miles further to travel. What was the whole distance?
- If 4 yards of wire $\frac{1}{8}$ of an inch thick weigh 6½ oz., what would 72 yards of wire $\frac{1}{4}$ of an inch thick weigh?
- Two merchants join their capitals, which are such that for every £3 advanced by A, B puts in £4. At the end of 4 months A increases his capital by $\frac{1}{3}$, while B withdraws $\frac{2}{3}$ of his. What portion of a loss of £170 at the year's end should each sustain?
- A sells at 3s. 6d. a gallon with 6 months' credit and 2½ per cent. discount; B sells at 3s. 5d. a gallon with 3 months' credit and no discount. How much per gallon does the one sell cheaper than the other, the use of money being equal to 10 per cent.?
- A person bought goods for £40, and sold half of them at a profit of 5 per cent. For how much must he sell the remainder so as to realise 20 per cent. upon the whole?
- A company has 50 ships averaging 375 tons each. In every 3 weeks 3 tons produce a clear gain of $\frac{1}{4}$ of a guinea, giving to each partner an annual income of £3,500. Find the number of partners.
- The rent of a farm is a fixed sum, together with the value of a certain number of bushels of wheat; when wheat is 56s. a quarter the rent is £250, when at 60s. it is £260. What will it be when wheat is 80s. a quarter?
- During the first six months of the year the income tax is at the rate of 7d. in the pound, and during the last six months it is at the rate of 5d. in the pound. If a person's income tax amounts to £21 what is his gross annual income?
- To what amount must goods worth £1,200 be insured at 1½ per cent. so as in case of loss to cover the value of the goods and the premium?
- A watch which loses 4 minutes daily is set right at 12 o'clock. What will be the true time a week afterwards when the hands point to 12 o'clock?
- By selling apples at 8 for 6½d. a person gains 8½ per cent. What would he gain or lose by selling 3 for 2½d.?
- A person borrows £163 6s. 8d. at 5 per cent. per annum, and at the same time £400 at 4 per cent. per annum. He repays altogether £581 9s. 2d. How long did he retain the money borrowed?
- By transferring £5,000 stock from the 3 per cents

at 72, to the 4 per cents, a person's income is increased £10. What is the market price of the latter stock?

- A person invests £120 at the end of each year at 5 per cent. per annum. How much will this amount to at the end of four years, reckoning compound interest?
- If the carriage of 1,875 tons for 60 miles be 9s. 4½d., what distance should 13½ tons be carried for 27s.?
- Bought 50 barrels of porter and 60 of ale for £380, and sold the whole for £412, at a profit of 7 per cent. on the porter, and 10 per cent. on the ale. What was paid for a barrel of each?

BOOK-KEEPING BY DOUBLE ENTRY.

THREE HOURS ALLOWED.

- What is book-keeping by double entry, as distinguished from single entry?
- When is a ledger kept by double entry said to balance?
- Can errors exist in a ledger that balances? If this be answered in the affirmative, support the answer by an example or examples.
- If, on examining the books, it be found that the following entries, viz.:—

Wine purchased of J. Smith.....	£100	0	0
Discount allowed by me to J. Locke ...	6	4	0

 have been journalized and posted as if they had been as follows, viz.:—

Wine purchased of J. Smith.....	£110	0	0
Discount allowed to me by J. Locke ...	6	4	0

 set forth the journal entries necessary to correct these errors.

- Journalize and post in proper technical form and language the following imaginary transactions, and make out from the ledger a trial balance, a profit and loss account, and a balance sheet:—
 John Ward takes W. Campbell into partnership on 1st January, 1866. John Ward's assets and liabilities are as follows, viz.:—

ASSETS.			
Sherry	£2,250	0	0
Brandy	300	0	0
Sundry debtors to him, viz.:—			
A. Green	200	0	0
J. Smith	50	0	0
T. Jones	100	0	0
Bills receivable.....	262	0	0
Cash.....	1,000	10	6
LIABILITIES.			
Bills payable.....	150	0	0
Due to P. Robb	20	10	0
Due to F. Brook	132	4	0
W. Campbell's capital amounts to £2,000 cash.			
N.B.—The capital and drawings of the partners are			

subject to interest at 5 per cent. per annum, and the balance of the profit and loss account is divisible thus:—
To John Ward, *two-thirds*; to W. Campbell, *one third*.

1866.	£	s.	d.
Jan. 1. Paid cash for purchase of business premises.....	1,500	0	0
„ Advanced for petty cash	20	0	0
2. Received cash from J. Wilson, in payment of his acceptance due this day	62	0	0
3. Consigned to P. Walker, to be sold by him on our account and risk, brandy invoiced at	225	0	0
„ Bought of F. Brook, sherry.....	75	0	0
4. Paid cash for our acceptance of J. Ward's draft, due this day	150	0	0
5. Sold P. Robb brandy	20	0	0
6. Received A. Green's acceptance, at 21 days, in payment of amount due by him ..	200	0	0
„ Received cash from J. Smith.....	50	0	0
8. Discounted A. Green's acceptance for £200, and received cash £198, and allowed discount £2	200	0	0
11. Advanced for petty cash	30	0	0
„ Received from P. Walker on account of consignment of brandy ..	100	0	0
12. Lent cash to J. Smith.....	100	0	0
13. Sold sherry for cash.....	400	0	0
„ Sold sherry to A. Green	800	0	0
„ Received from A. Green his acceptance, due 16th April.....	800	0	0
15. Bought sherry of J. Potts	1,500	0	0
„ Paid cash to J. Potts on account...	750	0	0
„ Accepted J. Potts' draft at 2 mos.	750	0	0
17. Bought brandy for cash	300	0	0
19. Cash drawn out by J. Ward	100	0	0
20. Received cash of T. Jones, by way of composition, in discharge of his debt of £100	50	0	0
22. Received account sales from P. Walker, showing that the above consignment of brandy to him realised net	285	0	0
„ Received cash from P. Walker, balance of amount realised, viz.	185	0	0
24. Paid cash for repairs of premises	10	6	0
25. Sold for cash, brandy	150	0	0
26. Paid cash for fire insurance.....	20	0	0
30. Bought sherry from J. Potts	900	0	0
„ Paid to J. Potts, A. Green's acceptance, due 16th April.....	800	0	0
„ Paid cash to J. Potts	100	0	0
31. Paid salary of clerk	10	0	0
„ Trade charges, paid out of petty cash	40	2	0
„ Interest on amount drawn out by J. Ward	0	3	4
„ Interest on J. Ward's capital.....	16	1	8
„ Interest on W. Campbell's capital ..	8	6	8
„ Stock of sherry in hand ..	3,925	0	0
„ „ brandy ..	100	0	0

ALGEBRA.

THREE HOURS ALLOWED.

1. Find the greatest common measure of $x^2 + x - 2$ and $x^2 + 3x + 2$, and also their least common multiple.

2. If S_i represents $\frac{a^i}{(a-b)(a-c)} + \frac{b^i}{(b-a)(b-c)} + \frac{c^i}{(c-a)(c-b)}$ prove that $S_0 = 0$ $S_1 = 0$ $S_2 = 1$.

3. Extract the square root of $13 - 4\sqrt{10}$ under the form of a quadratic surd.

4. Solve the equations:—

$$x - 2y + 3z = 10.$$

$$x + 3y + 2z = 25.$$

$$2x + y + 4z = 30.$$

5. Sum the series $1 - 2 + 3 - 4 + 5$, &c., to 101 terms.

6. A farmer bought a flock of 60 sheep, of which three died, but by selling the remainder at 2s. per head more than he paid for them, he realised a profit of £1 10s. on the transaction. Find the cost price of the flock.

7. If a number contains n digits, prove that its square root contains $\frac{n}{2}$ digits if n is even, and $\frac{n+1}{2}$ if n is odd.

8. If a and b are the roots of the quadratic equation $px^2 - qx + r = 0$, prove the equality $\frac{1}{a} + \frac{1}{b} = \frac{q}{r}$ and if $a = b$ find the relation between p, q, r .

9. Distinguish between interest and discount, and show that the latter is half the harmonic mean between the former and the principal sum.

10. Show that in the expansion of $\frac{1}{(1-x)^n}$ by the binominal theorem, the $(n-1)^{th}$ is half the n^{th} coefficient for all values of n .

11. Supposing the odds to be 3 to 2 against A solving one of these questions, 2 to 3 against B solving it, and that it is an even chance that C can do so; find the chance that a solution will be obtained if all three try.

GEOMETRY.

THREE HOURS ALLOWED.

To obtain a First-class Certificate, at least six problems and four propositions must be correctly done; to obtain a Second-class, at least four problems and eight propositions.

1. Draw a straight line perpendicular to a given straight line from a given point without it. Is Euclid's method always practically applicable?

2. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them of the other, the base of that which has the greater angle shall be greater than the base of the other.

3. Equal triangles, which are upon the same base and upon the same side of it, are between the same parallels.

4. If a straight line be bisected and produced to any point, the rectangle contained by the whole line thus produced, and the part of it produced together with the square of half the line bisected, is equal to the square of the straight line which is made up of the half and the part produced.

5. A segment of a circle being given, describe the circle of which it is a segment.

6. If from an external point two lines be drawn, one of which cuts a circle and the other touches it, the square of the touching line is equal to the rectangle under the segments of the cutting line.

7. Describe an isosceles triangle having each of the angles at the base double that of the vertical angle.

8. If the sides of two triangles about each of their angles be proportionals, the triangles shall be equiangular.

9. Equiangular parallelograms have to one another the ratio which is compounded of the ratios of their sides.

10. The rectangle contained by the diagonals of the quadrilateral figure inscribed in a circle, is equal to both the rectangles contained by its opposite sides.

11. Draw a straight line perpendicular to a given plane from a given point above it.

12. If a solid angle be contained by three plane angles, any two of them are greater than the third.

PROBLEMS.

1. Bisect a parallelogram by a straight line perpendicular to one of the sides.
2. The perimeter of an isosceles triangle is greater than that of an equal rectangle of the same altitude.
3. Find a square equal to the sum of two given rectilinear figures.
4. Given the base, the perpendicular, and sum of the sides of a triangle, construct it.
5. A ladder, AB, resting against a wall, CB, and on the horizontal ground, CA, begins to slide down. Show that the middle point of the ladder describes a circle round C.
6. If a circle roll within a circle of twice its diameter, any point in the first circle will trace out a diameter of the other.
7. Inscribe a circle in a given sector of a circle.
8. The opposite sides of any equiangular rectilinear figure must be parallel when the number of sides is even.
9. Find three points in the sides of a triangle, such that when they are joined the triangle shall be divided into four equal parts.
10. If A be the area of any triangle, prove that the area of a triangle whose angular points divide the sides of the former in the ratio of n to 1, is equal to $\frac{n^2 - n + 1}{(n + 1)^2} A$.

MENSURATION.

THREE HOURS ALLOWED.

1. Find the cost, at 3s. 10d. per yard, of the following pieces of oil-cloth: viz, 4 ft. 6 in. by 2 ft. 2 in.; 3 ft. 4 in. by 2 ft. 2 in.; 1 ft. 2 in. by 8 in.; and 1 ft. by 2 ft. 6 in.
2. The parallel sides of a trapezoid are 5 and 7 feet, and the diagonal, which is at right angles to these sides, is 7 feet; find the area and the other diagonal.
3. The area of a rectangular field is 2 acres 2 roods 32 perches, and its breadth is 300 links; find the number of hurdles, each two yards long, which will be required to enclose it.
4. Prove that a cord with its ends joined will enclose a greater area when in the form of a square than in the form of a triangle.
5. The area of a side of a cube is 21 feet 112 inches; find the solid content of the cube, and the length of its diagonal.
6. Give some method of arriving at the ratio which the circumference of a circle bears to its diameter.
7. The outer and inner circumference of a circular ring are 26 and 18 feet; find the area of the ring.
8. Find the radius of a segment-arch, having given the span and the rise.
9. A hollow cylinder, made of a material one-fifth of an inch thick, measures 22 inches round on the outside, and is 10 inches deep; find how many pints it will contain.
10. How many bullets, half an inch in diameter, may be made from a cwt. of lead the specific gravity of which is 11.2?
11. The solid content of the frustum of a pyramid is 259 feet 432 inches, the area of its two ends 48 and 75 feet; find its height.
12. A common garden pot is 21 inches round the top, 15 round the bottom, and 7 down the side; find the shape and size of a piece of paper which will surround it.

TRIGONOMETRY.

THREE HOURS ALLOWED.

1. If the unit of angle be an angle the subtending arc of which is twice the radius, what would be the numerical representation of 90° ?
2. If $\tan^2 x = \tan. (a-x)$, $\tan. (a+x)$, then will $\sin. 2x = \sin. a \sec. \frac{\pi}{4}$
3. Find x from the equation—
 $1 + \cos. (x+a) = \cos.^2 (2x-a) + \cos.^2 (x-2a)$

4. If versed $\sin. A = \frac{1}{13}$ find the other trigonometrical ratios.

5. Find the 540th root of .00007, having given—
 $\log. 7 = .8450980$; $\log. 9.824394 = .9923057$
6. Express the area of a quadrilateral figure in terms of its diagonals and their inclination.
7. Prove that—

$$\tan.^{-1} a + \tan.^{-1} b = \tan.^{-1} \frac{a+b}{1-ab}$$

and thence deduce a rapidly converging series for the calculation of π .

8. If C be an angle of a triangle, of which the sides are a, b, c , prove that—

$$c = (a-b) \cos. \frac{C}{2} \sqrt{1 + \left(\frac{a+b}{a-b} \tan. \frac{1}{2} C \right)^2}$$

9. If $2S = a + b + c$, show that the area of a triangle

$$= \sqrt{S(S-a)(S-b)(S-c)}$$

and that it is rational, if $a = xy(u^2 + z^2)$; $b = uz(x^2 + y^2)$; $c = (yu + xz)(yz - ux)$.

10. A hexagon is inscribed in a circle radius r , and the alternate angles are joined, the joining lines forming another hexagon. Prove that the area of this last hexagon is $\frac{\sqrt{3}}{2} r^2$

11. If O be the centre of the circle inscribed in the triangle A B C; $\angle A O B = \alpha$; $\angle A O C = \beta$; $\angle B O C = \gamma$; then

$$4 \sin. \alpha \sin. \beta \sin. \gamma = \sin. A + \sin. B + \sin. C$$

12. If $2 \cos. A = x + \frac{1}{x}$, prove, without assuming De Moivre's theorem, that—

$$2 \cos. \frac{1}{2} A = x^{\frac{1}{2}} + \frac{1}{x^{\frac{1}{2}}}$$

13. Given $a = 85.63$ $\angle C = 48^\circ 24'$
 $b = 78.21$ find A and B

$$\log. 1.6384 = .2144199 \quad \text{L. cot. } 24^\circ 12' = 0.3473497$$

$$\log. 7.42 = .8704039 \quad \text{L. tan. } 5^\circ 45' = 9.0030066$$

$$\text{Diff. for } 1' = 1265.5$$

14. Define the polar angle of a spherical triangle, and prove that its sides and angles are the supplements of the angles and sides of the primitive triangle.

15. Assuming the relation between the three sides and an angle of a spherical triangle, deduce the relation between the three angles and one side.

16. Investigate the formula—

$$\tan. \frac{1}{2} (A-B) = \frac{\sin. \frac{1}{2} (a-b)}{\sin. \frac{1}{2} (a+b)} \cot. \frac{1}{2} C$$

17. Hence prove that—

$$\sin. \frac{1}{2} (A-B) \sin. \frac{1}{2} c = \sin. \frac{1}{2} (a-b) \cos. \frac{1}{2} C$$

CONIC SECTIONS.

THREE HOURS ALLOWED.

SECTION I.—GEOMETRICAL CONICS.

1. What is a cone? Show that a section of a cone made by a plane which cuts both slant sides is a *symmetrical curve*.
2. Prove that the tangent to a conic, measured from the point of contact to the directrix, subtends a right angle at the focus.
3. Draw a pair of tangents to a parabola from a point without it.
4. If SY is the perpendicular from S, the focus of a parabola, on the tangent at P, prove that—
(1.) Y is on the tangent at the vertex.
(2.) $SY^2 = SA \times SP$.
5. Define an ellipse, its centre, foci, vertices. If the

major and minor axes of an ellipse are given, how can the ellipse be described by continuous motion, and what will be its area?

6. Prove that in the ellipse $CN \times CT = CA^2$, where C is the centre, and T is the point in which the tangent at P meets the major axis, NP being the ordinate. What is the corresponding property of the parabola?

7. What are conjugate points on an ellipse? If P and D are conjugate points, show that $SP \times PH = CD^2$: $CP^2 + CD^2 = CA^2 + CB^2$.

8. Prove that the tangent at any point of a hyperbola bisects the angle between the focal distances.

8. Prove, by the method of projections or otherwise, that the hyperbola has asymptotes.

10. If the chord Qq of a hyperbola meets the asymptotes in R and r , prove that $QR = qr$. Hence prove that the area of a triangle contained between the asymptotes of a hyperbola and a tangent is constant.

11. Prove that all conics may be projected into circles. Hence prove Pascal's theorem.

SECTION II.—ANALYTICAL CONICS.

12. Determine the relation between the constants when $y = mx + c$ is perpendicular to $y = nx + b$. Find the length of the perpendicular from (x_1, y_1) on $ax + by + c = 0$.

12. What is the area of the triangle contained between the three lines $y = mx, y = nx, ax + by + c = 0$? Show that the result expresses space in two dimensions.

14. Find the centre and radius of the circle whose equation is

$$x^2 + y^2 - 4x + 6y - 3 = 0.$$

What are the equations to the tangents which are equally inclined to the co-ordinate axes?

15. If the base and vertical angle of a triangle are given, prove that the locus of the vertex is a circle.

16. Prove analytically the theorems contained in 4, 6, 7, 10 of the preceding section.

17. Find the polar equation of the ellipse, when the focus is the pole. What does the equation become when $e = 1$?

18. Prove that the locus of the middle points of a system of parallel chords of a parabola is a straight line parallel to the principal diameter of the curve.

NAVIGATION AND NAUTICAL ASTRONOMY.

THREE HOURS ALLOWED.

SECTION I.

1. The arc joining the poles of two great circles subtends an angle at the centre equal to their inclination; and the point of intersection of the great circles is the pole of the great circle in which the poles lie.

2. The area of a spherical triangle is the same fraction of the area of a hemisphere that the excess of sum of its three angles above two right angles is of 360° .

3. In any spherical triangle prove the formula:—

$$\text{Cot. } a \sin. b = \text{Cot. } A \sin. C + \text{Cos. } b \cos. C.$$

SECTION II.

1. Prove the formulæ:—

$$\tan. \frac{1}{2}(a+b) = \frac{\cos. \frac{1}{2}(A-B)}{\cos. \frac{1}{2}(A+B)} \tan. \frac{1}{2}c.$$

$$\tan. \frac{1}{2}(a-b) = \frac{\sin. \frac{1}{2}(A-B)}{\sin. \frac{1}{2}(A+B)} \tan. \frac{1}{2}c.$$

2. One angle of a triangle is a right angle. Write down the equations which connect the other angles and the sides, and prove them.

3. Having given the three angles of a spherical triangle, find the sides.

SECTION III.

1. Find the compass course and distance from A to B , having given—

Lat. A $35^\circ 18' N$. Variation 2 pts. E . Long. A $85^\circ 18' W$.
 „ B $35^\circ 18' N$. Deviation $8^\circ 50' E$. „ B $43^\circ 22' W$.

2. On June 23rd, at noon, a point of land in lat. $45^\circ 27' N$, long. $15^\circ 35' W$, bears by compass $N.N.W.$, variation $1\frac{1}{2}$ pt. E , deviation $8^\circ 15' W$, distant 15 miles; afterwards sailed by compass during the next 24 hours as follows:—

K.	10ths.	Courses.	Wind.	Leeway.	Deviation.
79	8	ENE	EbS	$1\frac{1}{2}$	$8^\circ 15' E$
58	5	SbW	ESE	1	$9^\circ 12' W$
75	7	NNE $\frac{1}{2}$ E	WNW	$1\frac{1}{2}$	$8^\circ 30' E$

Required the latitude and longitude in on June 24th at noon.

3. Required the distance on a great circle from A to B given.

Lat. A $18^\circ 15' N$ Long. A $33^\circ 12' W$.
 „ B $53^\circ 21' N$ „ B $75^\circ 18' W$.

SECTION IV.

1. Feb. 11th, 1866, in long. $100^\circ 15' W$, the observed meridian altitude of the sun's lower limb was $36^\circ 25' 10''$ (zenith N of the sun) index error $+ 3' 15''$ and the height of the eye above the sea was 12 feet. Required the latitude.

2. June 9th, a.m. in lat. $10^\circ S$, long. $31^\circ 30' E$, when a chronometer showed $7h. 33' 35''$ (it being June 9th, a.m. at Greenwich) the observed alt. sun's L.L. was $42^\circ 35' 10''$. Index error $+ 1' 50''$ and the height of the eye above the sea 19 feet. Required the longitude.

On May 8th at noon, the chronometer was too fast on $G. M.$ time $36' 10.5''$, and its daily rate was $2.5'$ losing.

SECTION V.

1. Define *course*, *distance*, *rumb-line*, and *departure*, and illustrate by a diagram.

2. Prove that distance = departure \times cosec. course.

3. Prove the rule for finding the meridional parts for a given latitude.

SECTION VI.

1. Obtain an expression for computing the altitude of a given celestial body for a given time.

2. Prove the rule for finding the latitude by altitudes of any celestial object observed near the meridian.

3. Prove a rule for clearing a lunar distance of the effects of refraction and parallax.

SECTION VII.

Describe the sextant, and prove the rule for graduating it.

SECTION VIII.

1. December 4th, at $8h 10m$ a.m., latitude $50^\circ 15' N$, long. $160^\circ 45' E$, the sun rose by compass $S. 61^\circ 15' E$, the ship's head being N , deviation $2^\circ 45' E$, when the observed altitude of sun's L.L. was $7^\circ 10' 40''$. The index error $+ 2' 10''$, and the height of the eye 17ft. Required the variation.

2. September 23rd, in lat. $47^\circ 58' N$, long. $67^\circ E$, the following double altitudes were observed:—

Meantime nearly.	Chronometer.	Obs. alt. Sun's L.L.	True bearing.
9h. 30m. a.m.	9h. 31' 40"	$36^\circ 20' 40''$	$S.E.b.E.$
1h. 40m. p.m.	1h. 41' 30"	$30^\circ 15' 20''$	$S.W.b.W.$

The run of the ship in the interval was $S.b.W.$ 18 miles, the index error was $+ 3' 40''$, and the height of the eye was 20 feet. Required the latitude at the time of taking the second observation.

PRINCIPLES OF MECHANICS.

THREE HOURS ALLOWED.

1. How are forces geometrically represented? State some cases in which forces acting on a particle evidently balance one another.

2. Into how many classes, and according to what distinctions, are levers usually divided? Give examples of each class. Prove that in the most general case the moments of the forces which balance one another on a lever about the fulcrum are equal.

Ex. Two weights of 3 lbs. and 7 lbs. respectively hang from the extremities of a lever one yard long; find the

fulcrum, (1) on the supposition of the lever being weightless; (2) on the supposition of its weighing 10 lbs.

A body placed in one scale of a false balance appears to weigh 9 lbs., when placed in the other to weigh 16 lbs. What is its true weight?

3. Show that every system of particles and every body of matter has one and only one centre of gravity. How would you practically find it in each of the cases?

A straight wire 5 feet long is composed of two pieces of 3 feet and 2 feet in length respectively. The former is composed of matter which weighs 1 oz. per foot, and the second of matter which weighs $3\frac{1}{2}$ oz. per yard. Find the centre of gravity of the whole wire.

4. What is meant by the principle of virtual velocities? Prove that it exists in the case of the screw.

5. State the experimental laws of statical and dynamical friction. Prove that the coefficient of friction is equal to the tangent of the limiting angle of resistance.

6. What is meant by the expression "Accumulated work?"

Required the work accumulated in a ball whose weight is 5 lbs., and whose velocity is 10 feet per second.

7. Prove that if, the ordinary units being chosen, U express the work accumulated in a body, V its velocity, W its weight, g the accelerating force of gravity,

$$U = \frac{V^2 \times W}{2g}$$

A train weighing 60 tons has a velocity of 40 miles per hour when the steam is turned off, how far will it ascend an incline of 1 in 100, taking the friction at 8 lbs. per ton?

8. What is meant by the centre of gyration? Investigate its position in a plane ring like the rim of a fly-wheel.

The weight of a fly-wheel is 13 cwt. The internal and external diameters of the ring are 9 and 10 feet. Find the centre of gyration. The wheel makes 30 revolutions per minute. The diameter of the axis is 3 inches, and the friction upon it one-seventh of the whole weight. How many revolutions will the wheel make before it stops?

9. Describe the common wheel barometer. What are its peculiar defects? What are those which it shares with the common barometer? How are they remedied in the best instruments?

Why does a barometer fall in unsettled weather?

10. Explain the action of the syphon. For what purposes is it commonly used? Explain by it the cause of intermittent springs.

11. A sloping embankment is subjected to the pressure of water. Supposing it to be of the form of a rectangle, investigate (1) the amount of pressure; (2) the point where the resultant acts.

Required the pressure on the staves of a cylindrical barrel filled with water, the diameter of the base being 3 feet and the height 4 feet.

12. Describe a fire-engine.

The section of the pipe of a fire-engine is 1 sq. inch, and the velocity of the water discharged is 50 feet per second. Required the horse-power necessary to work the engine.

13. What is the distinction between a simple and a compound pendulum? Prove that in the latter the centres of suspension and oscillation are reciprocal.

Determine the distance between them in a body that vibrates in 3 seconds.

14. Supposing the annual fall of rain over the whole earth to be 4 feet in depth, and to have descended from the height of half a mile, what is the work of the sun by evaporation in the course of a year, estimated in horse-powers?

PRACTICAL MECHANICS.

THREE HOURS ALLOWED.

1. Upon what principle are the teeth of a pair of wheels arranged, when the wheels are required to com-

municate motion between two shafts, whose directions meet at right angles in a point, and one of which is to rotate faster than the other in the proportion of three to two?

2. Define a screw surface, and the pitch of a screw. What are the forms of screw thread usually employed, and how do they differ in their mechanical properties?

3. Explain the contrivance known as the *eccentric*, and show that it is a mechanical equivalent for the crank and connecting rod.

4. Describe some form of quick return movement suitable for actuating the table in a planing machine.

5. Explain the method of arranging change wheels in a screw cutting lathe, and select some numerical example to show how a screw of a required pitch may be cut in a given lathe.

6. In a train of three wheels in gear, whereof the first is fixed, and the other two are attached to an arm, which is capable of revolving about the centre of the first wheel, upon what principle can you arrange that the third wheel shall be carried round upon the arm without rotating at all upon its own axis? Hence show how a wire sheathing may be laid upon a rope without any twist being given to the wires.

7. What is the action of the fusee of a spring clock?

8. Explain the different modes in which the steam acts in the atmospheric, condensing, and high pressure steam-engines, pointing out the great improvement introduced by Watt.

9. Describe some form of steam slide-valve, and explain its action.

10. Why is it economical to work steam expansively?

11. Explain the principle upon which a locomotive boiler is constructed.

12. Why did the introduction of the screw propeller render a modification of the marine steam-engine necessary? Describe the general arrangement of a trunk engine, and the form of a screw propeller.

ELECTRICITY AND MAGNETISM.

THREE HOURS ALLOWED.

1. State the direction of the lines of magnetic force between the poles of a bar-magnet, and the means of observing them.

2. What is the nature of magnetic force? Can it properly be called an attractive force? Give an experimental proof of your answer.

3. What elements of the earth's magnetism have been observed and recorded, and by what instruments?

4. How may the errors of a ship's compass be ascertained and corrected?

5. Describe the peculiar magnetic properties of *bismuth*, and mention other bodies possessing similar properties.

6. Explain the two kinds of free electricity, and the means of distinguishing between them.

7. Describe the action of an insulated electrified body on other bodies near, but not in contact with it.

8. Explain the different effects produced when a *point* or a *knob* is presented to an electrified body; and apply this principle to the construction of a lightning conductor.

9. How is a voltaic current produced? What actions occur in any given element of a battery?

10. What forms of battery are preferred for (a) uniformity, (b) durability, and (c) intensity of current?

11. Describe some of the processes employed in electro-metallurgy.

12. What means have been adopted for testing the insulation of a submarine cable in the course of construction?

13. Explain the construction of a Morse printing telegraph.

14. Explain Wheatstone's "bridge," and its application in discovering a *fault* in a circuit.

15. What must be the relative directions of two currents, that one may rotate round the other? Explain the cause of the rotation.

16. Describe the construction of a thermo-electric pile, and the form generally adopted in experiments on radiant heat.

17. Describe the electric organs of the torpedo.

18. In what kind of animals do manifestations of electric force continue longest after death? How may a battery be constructed of dead animal tissue?

LIGHT AND HEAT.

THREE HOURS ALLOWED.

GEOMETRICAL OPTICS.

1. State the law of the intensity or brightness of light, at different distances, from a luminous origin of light. Show how this law is employed in photometry to find the relative brightness of lights, describing some form of a photometer, and the mode of using it. If a gas flame at 10 feet distance gives an equal illumination on a screen with a lighted candle at 4 feet, what is the illuminating power of the gas light compared with that of the candle.

2. When an image of an object is formed by a *convex spherical mirror*, show that it is always *virtual, erect, and diminished*. Show how a convex mirror is employed in Cissegrain's telescope, and show how it then furnishes a *real* secondary image of the distant object towards which the telescope is directed.

3. Explain how the prismatic spectrum is formed when a beam of light passes through a refracting prism. State the circumstances to be attended to in order to obtain a pure prismatic spectrum. What are meant by Fraunhofer's fixed lines of the solar spectrum?

4. Explain the causes of long and short-sightedness, and show the forms of the lenses required to correct them respectively. When the eye views an image of an object through a single convex lens, as a simple microscope, show how the magnifying power arises, and find an expression for it.

PHYSICAL OPTICS.

5. Enunciate the law of the ordinary refraction of light by transparent media, and name some media for which it holds good, both crystallized and uncrystallized. Describe the nature of the refraction in the crystals called uniaxial crystals, and also in those called biaxial crystals.

6. Describe the construction of a simple polariscope made with pieces of window glass. Show the properties of the reflection at transparent surfaces on which it acts, and describe the experiments which may be tried with it.

7. Show how the property of interference of light is demonstrated by the experiment with the two mirrors slightly inclined, or the obtuse-angled prism. Explain how interference proves the property of periodicity in light, and show how the luminiferous interval can be measured for any given colour.

8. Describe the apparatus required for showing the rings and brushes seen in polarized light around the optic axes of uniaxial crystals. Show the circumstances when the black and bright brushes are seen respectively. Describe also the appearance when the light is either *circularly* polarized or *circularly* analyzed.

HEAT.

9. Explain what is meant by radiant heat, and state the properties which it possesses in common with light. Describe an experiment which shows that the amount of radiation from the surface of a heated body depends greatly on the state of the surface.

10. Describe the construction of the differential air thermometer, and show the advantages it possesses in certain cases. State some experimental investigations where it would be more useful than a common thermometer.

11. Explain what is meant by the specific heat of bodies, and describe the method of finding it for solid bodies by the method of immersion. The specific heat of water being taken as unity, what are the specific heats of iron, silver, and lead?

12. Show how the elastic force of vapours can be determined when less than that of the atmosphere. Describe the construction and mode of action of the old atmospheric pumping engine. What were its disadvantages?

CHEMISTRY.

THREE HOURS ALLOWED.

No candidate is allowed to answer more than three questions in each division.

FIRST DIVISION.

1. Describe by an equation the action of hydrated sulphuric acid on manganic binoxide. What weight of the binoxide would be needed for the preparation of a kilogramme of oxygen? $\text{Mn} = 55$; $\text{O} = 16$.

2. The equation $\text{Fe}^3 + (\text{H}^2 \text{O})^4 = \text{Fe}^2 \text{O}^3 + \text{H}^2$ represents the action of steam on red-hot iron. What weight of iron is thus oxidized by the decomposition of 9 kilogrammes of steam? $\text{Fe} = 56$; $\text{H} = 1$.

3. 500 cubic centimetres of pure and dry air were measured off at 0°C , and 760 millimetres barometric pressure, and mixed with 250 cubic centimetres of hydrogen under like conditions. What will be the volume of the residue after explosion, and what its per-centage composition?

4. What volume of oxygen is needed for the combustion of a litre of sulphuretted hydrogen? What volume of sulphurous acid is formed?

5. Describe and explain the manufacture of phosphorus from bone earth. How is red phosphorous prepared from clear phosphorus.

6. How would you separate silica from the other constituents of felspar, viz. alumina and potash.

SECOND DIVISION.

7. A solution acid to test paper is precipitated black by the action of sulphuretted hydrogen. How would you examine the precipitate for the detection of the metals contained in it?

8. A strongly alkaline liquid forms a white precipitate by the action of hydric sulphate ($\text{H}^2 \text{SO}^4$). Chlorine forms a brown precipitate in the original solution. The brown precipitate is soluble in strong hydrochloric acid with evolution of chlorine and formation of a crystalline chloride. What would you suspect the original liquid to have contained, and how would you test it?

9. Describe the ordinary process for the manufacture of metallic lead, and the separation of silver from lead.

10. What compounds of manganese are there analogous respectively to compounds of calcium, iron, sulphur, and chlorine? How do these compounds decide the atomic weight of manganese, its equivalent weight being previously known?

11. Describe by equations the following reactions, viz., I., the precipitation of argentic nitrate (nitrate of silver), by hydro-di-sodic-phosphate (common phosphate of soda). II. The action of strong hydrochloric acid in excess on potassic dichromate (red chromate of potash). III. The action of sulphuretted hydrogen on bismuthic chloride.

12. How is magnesia prepared? How metallic magnesium? Describe the chief reactions of the salts of magnesia.

THIRD DIVISION.

13. How is pure alcohol obtained from sugar?

14. Describe the preparation of pure benzole? What is its composition? How much heavier than hydrogen is its vapour? What does commercial benzole usually contain?

15. Describe by an equation the action of litharge and water on stearine.

16. What is the meaning of the term amide? Describe the formation and chief properties of acetamide, oxamide, and carbamide.

17. What are the constituents of coal gas? How

could you prove the presence of each of them in the gas?

18. The silver salt of an organic acid yielded by combustion 114 per cent. of carbonic acid and 42 per cent. of water. It was also found to contain 55.95 per cent. of silver. Calculate the formula of the salt.

MINING AND METALLURGY.

THREE HOURS ALLOWED.

1. Describe the English process of manufacturing wrought iron from ordinary pig-iron.
2. In what way is copper obtained from sandstone ores, containing from $1\frac{1}{2}$ to 2 per cent. of that metal?
3. Describe the Frieburg method of amalgamation.
4. Where are tin ores principally found, and how are they prepared for the market?
5. How would you extract the metals, in a country in which wood and charcoal are the only available fuel, from an ore containing 30 per cent. of lead, and 40oz. of silver to the ton of mineral?
6. Describe Bessemer's process for manufacturing steel.
7. Give the respective approximate compositions of Welsh coal, anthracite, and north country steam coal.
8. What amount of power will be expended in pumping per minute 800 gallons of water from a depth of 520 feet?
9. Describe the ordinary round buddle employed for slime dressing.
10. Describe the iron ores of the Cleaveland districts, and state in what geological formation they occur.
11. How would you determine the amount of ash contained in a specimen of coal?
12. Describe the method employed for making the survey of a mine in which the presence of iron interferes with the action of the magnetic needle.

BOTANY.

THREE HOURS ALLOWED.

The candidate is expected to answer correctly three questions in Section I, and six questions in Sections II. and III., including descriptions of at least two of the fresh specimens. Nos. 8, 9, and 10 each stand for an answer.

SECTION I.—STRUCTURE AND PHYSIOLOGY.

1. Define the following terms, and give examples in illustration as required.
Diadelphous. Give examples from two Natural Orders.
Orthotropous. Give two Natural Orders in illustration.
Circumscissile. Name fruits of genera belonging to two Natural Orders in illustration.
Accrescent. Give an example.
2. What are *Stipules*? In which British Natural Orders are they generally present? In which absent?
3. Explain the structure and function of *Leaves*.
4. What is the function of *Albumen*? Name six British Natural Orders which generally have *albuminous*, and six which have *exalbuminous* seeds.
5. Name the essential *elementary constituents* of plants.
6. What functions are liable to be interfered with in *transplanting*? And how is fatal disturbance to be guarded against?

SECTION II.—SYSTEMATIC AND ECONOMIC BOTANY.

1. State the principles upon which plants are *classed*.
2. Which natural orders furnish the following products? State the part of the plant affording each:—*Cotton*, *saffron*, *mace*, *colza-oil*, *arnatto*, *sugar*.
3. Distinguish *Rosaceæ* from *Leguminosæ*.
4. Distinguish the genera *Oak* (*Quercus*), *Chestnut* (*Castanea*), and *Beech* (*Fagus*).
5. Describe the usual structure of the flower in *Grasses*.
6. Describe the principal modifications of the *capitulum* and of the *fruit* and its appendages in British *Compositæ*.
7. Name the *Natural Order* to which the plants marked A. B. and C. respectively belong, with *reasons* for your opinion.

SECTION III.—DESCRIPTIVE BOTANY.

8, 9, and 10. Describe the three plants marked A, B, and C, in the proper sequence of their organs, and in accordance with the examples given in Lindley's "Descriptive Botany" and Oliver's "Lessons" (Append ix).

FLORICULTURE.

THREE HOURS ALLOWED.

1. What are the conditions most favourable to the germination of seeds?
2. Describe the process of budding, and point out in what respect it differs from grafting.
3. How and by what means, if at all, may hardier races of any particular kind of plant be obtained?
4. For what special cultural purposes are "span-roofed" and "lean-to" houses most suitable?
5. Suppose a conservatory has to be decorated at Christmas with flowers, some in their natural season, others forwarded or retarded by artificial treatment. Name a few of the leading plants which will naturally be in a condition to be used for that purpose, and name also some of the most important of those which would have to be prepared artificially, indicating in general terms the mode of preparation.
6. The showy Pansy of the garden is understood to have been produced from one of our wild pansies. Describe how this change can have been effected.
7. What are the conditions and processes, at the flowering stage of a plant, necessary to the production of fertile seed?
8. What system of treatment would be specially conducive to the production of abundance of blossoms, and what would be most conducive to a paucity of blossoms? Take greenhouse Azaleas and Pelargoniums as examples.
9. Name the principal decorative plants available for the garden, greenhouse, and stove, in the different months of the year, in establishments where both stove and greenhouse accommodation are provided.
10. How should forcing houses be ventilated, and for what reasons mainly is ventilation necessary in such structures—to which artificial heat, it is to be remembered, is being at the same time applied?
11. Describe the process of hybridizing plants, and the conditions necessary to a successful result—that is, the actual production of hybrids.
12. In what way is bottom-heat important in plant-culture, and how is it best applied?

FRUIT AND VEGETABLE CULTURE.

THREE HOURS ALLOWED.

I.—FRUIT-TREE CULTURE.

1. Give a list of 12 varieties of dessert apples to ripen in succession from August till May, and in the order in which they are ready for use.
2. The same of pears.
3. Give a list of eight varieties of kitchen apples to come into use in succession from August of one year till August of the year following.
4. Give a list of six varieties of dessert plums to ripen in succession from July till November, arranged in their order of ripening.
5. The same of cherries from May till September.
6. Name six varieties of the best peaches and state the order in which they ripen.
7. The same of nectarines.
8. The same of apricots.
9. What are the various stocks used for the propagation of the apple, and what is the effect each has on the scion?
10. What is the best form in which to train fruit trees for open fruit garden culture; and when ought the pruning of these trees to be performed so as most effectually to economise the vigour of the tree and develope the greatest amount of fruit-bearing wood?

11. What is the object for which root-pruning is practised, and at what season and in what manner is this operation to be performed?

12. Describe the process by which trees absorb moisture by their roots, and by which the sap circulates throughout their system.

13. Why are the upper shoots on a branch developed with greater vigour than the lower?

14. How is a branch increased in thickness?

15. How is a branch increased in length?

16. What are the functions of the leaves, and what is the influence that stimulates their operation?

17. Do trees absorb moisture by their roots and leaves only; and, if not, through what medium?

18. What are the substances that constitute the food of trees, and how are they conveyed and assimilated into their system?

19. What are the causes that induce canker and gum in fruit trees, and how are these causes to be removed or prevented?

20. Describe in detail, as concisely as possible, the forcing of vines for a crop to be ripe early in February, stating the period when the vines are started, the various degrees of temperature employed, and every operation practised in the course of the process.

II.—VEGETABLE CULTURE.

21. Give a list of six varieties of peas to furnish a supply in succession from May till October, and state the periods when the seed of each should be sown.

22. Describe the cultivation of broccoli, stating the soil best adapted for it, and the mode of its preparation; also the varieties to be employed in securing a succession of supply throughout the year, beginning in August.

23. Describe in detail the process of making a hotbed.

24. Prepare a list of the kinds and quantities of vegetable seeds and roots necessary for cropping a garden of half an acre throughout the year.

ANIMAL PHYSIOLOGY.

(IN RELATION TO HEALTH.)

THREE HOURS ALLOWED.

1. Describe the structure of the human lung, commencing at its root, and including the air tubes, air cells blood-vessels, lymphatics and nerves.

2. When, where, and how, is the gastric juice formed? Give an account of its composition and its action in the economy.

3. Enumerate the parts which serve as protective organs to the eyeball. Describe briefly their position and structure, and give the use of each.

4. Suppose a person to be suddenly immersed in carbonic acid gas, how and by what form of nervous and muscular action is suffocation produced? Name the parts which are concerned in the stoppage of the breath, and say how each acts.

5. What poison or poisons destroy human life in the case of exposure to the fumes of burning charcoal, or to the smoke of accidental fires in close rooms? What preliminary and other precautions can be taken to enable one to enter such apartments to save human life?

DOMESTIC ECONOMY.

THREE HOURS ALLOWED.

SECTION I.

1. Describe a convenient and economical dwelling for a working man and his family, say of four children.

2. What circumstances would influence you in the choice of a dwelling-house?

3. Give advice concerning the selection and purchase of household furniture.

4. What are the evils of the "tally" system?

5. What are the effects, moral and physical, of overcrowded dwellings in town and country? What remedies can you suggest for these evils?

6. Give an outline of the practical instruction which the mother of a well-regulated family, in which there are daughters intended for domestic service, may give to them in her own daily work.

7. What occupations of the labouring classes in our towns do you consider the least healthy, and why?

8. Explain what is meant by the words *cheap* and *dear*, in purchasing articles of food and clothing, and in other domestic arrangements for a family.

9. What are the advantages of purchasing articles of daily use, such as coal, tea, sugar, &c., for ready money rather than on credit? State what you think is the cheapest and best mode of supplying a family with these necessary articles.

10. Describe the best dinner you could provide for four children, costing only one shilling.

11. Compare the advantages of linen, cotton, and woollen clothing, with regard to durability, health, and economy.

12. Give directions for washing woollen articles, and for getting up fine linen. Give reasons for the process you recommend.

13. Write a short essay on the most common habits injurious to health and strength.

14. How may hard water be rendered soft?

15. What are the advantages and disadvantages of an open fire-place? What precautions should be observed in the use of close stoves?

16. Why are baking and frying objectionable as a means of cooking meat? Give minute directions for boiling a leg of mutton, and your reasons for such directions.

17. In what respects does coffee differ from tea as an article of diet? Which is the most nourishing and wholesome, tea, coffee, or cocoa? Why?

18. Give clear and simple directions for the management of a sick room. What are the essential qualities of a good nurse?

19. What articles of food keep up animal warmth, supply the waste of muscle, and produce bone?

SECTION II.

1. Describe the chemical action which goes on in the burning of a candle, and explain what takes place on blowing the fire with a pair of bellows.

2. Of what substances is flesh composed? Are they all equally valuable for purposes of nutrition? Why is beef less digestible than mutton, and the heart of an ox or sheep less so than the tongue?

3. Why is the potato valuable as an article of food, since it contains little nutritive matter? Why do we use salt with our food generally?

4. Why is bread made from wheat *meal* more nourishing and wholesome than that made from wheat flour? Compare oatmeal and wheat flour as articles of diet.

5. Hard water may safely be preserved in tanks lined with lead; soft water becomes poisonous under such circumstances. Why?

6. What are the chief articles of food in tropical, temperate, and Arctic climates respectively, and why? Can you account for the large consumption of alcohol in countries where moisture and cold accompany each other?

POLITICAL AND SOCIAL ECONOMY.

THREE HOURS ALLOWED.

Questions from Stephens's Commentaries.

1. Under what different heads does Stephens consider right in private relations.

2. How far is marriage in England a civil, and how far is it a religious contract?

3. What are by the common law the rights of the husband to the property of his wife, distinguishing between land, and money or other personal property?

4. At what time does the right of the father to the control over the persons of his children cease, and by what act may that control be sooner taken away?

5. What do you mean by Parliament?
6. What are the chief privileges of Parliament?
7. What is the title of her Majesty to the throne of this kingdom?
8. What are the duties of the Sovereign to the people, and how are they defined by the Coronation Oath?
9. Describe the offices of sheriff and coroner.

Questions from Professor Fawcett's Manual, for those who aspire to a First-Class Certificate.

1. How does Mr. Fawcett divide commodities with reference to the causes which regulate their price?
2. Give the history and explain the use of the co-operative system in its different forms.
3. What are the functions of credit, and is it rightly considered to be capital?
4. What determines the rate of wages, and why cannot this rate be permanently or beneficially affected by law?
5. What are the different advantages, according to different circumstances, of farming on a large and on a small scale?
6. Explain the incidence of the land tax, tithe rent charge, and rates chargeable on the occupation of land and houses. Is there any and what difference between land and houses in respect of this incidence?

GEOGRAPHY.

THREE HOURS ALLOWED.

1. Describe briefly the general distribution of high and low ground in Great Britain, naming the counties in which the principal hill-ranges are situated.
2. Mention, in the case of Great Britain and Ireland, the cities and towns that constitute great seats of manufacturing industry (cotton, woollen, linen, hardware, earthenware), naming the county to which each belongs; also name six or more of the principal seaports of Britain, describing their situations.
3. Describe briefly the physical geography of either France, Italy, or Germany—boundaries, mountains, plains, rivers-basins, and climate. (N.B. If you prefer it, draw a map of any one of those countries, embodying, as to natural features, the required information.)
4. Give some account of the Mediterranean Sea—naming the countries that lie around its basin, and the chief seaports situated on its shores.
5. Give a brief description of the physical features of India—distribution of high and low grounds, river-basins, &c., with the leading conditions of its climate.
6. Name the principal towns that lie within the valley of the Ganges—the valley of the Indus—on the plateau-lands of the Deccan—and upon the Malabar and Coromandel coasts respectively. Say which among them are most distinguished by size and population.
7. Specify the distinguishing conditions in the physical features, climate, and natural productions, of the Australian continent.
8. Draw a map either of New South Wales, Victoria, or Tasmania—marking on it the direction of the high grounds, courses of the principal rivers, and positions of the principal towns.
9. Describe briefly the natural features of New Zealand: name also the provinces into which either island is respectively divided, with the chief town of each.
10. State the received conditions which account for the existence of ocean currents; name the principal currents of the Atlantic, describing particularly the course of the Gulf Stream.
11. To what causes are differences of climate to be chiefly assigned? Account for the differences in point of temperature between Tibet and the valley of the Ganges, between Lapland and Egypt, between the cities of Quito and Panama, between Central Africa and Polynesia.
12. Give some account of the geographical distribution of regions of subterranean disturbance (earthquakes and volcanic eruptions): name three or more of the prin-

cipal active volcanos of either hemisphere, stating their localities.

ENGLISH HISTORY.

THREE HOURS ALLOWED.

1. Give the dates of the following events:—The landing of Cæsar in Britain; the invasion of the Anglo-Saxons; the mission of St. Augustine; the Norman Conquest; the Accession of Henry II.; Magna Charta; the Accession of Henry VII.,—of James I.; the flight of James II.; the Bill of Rights; the death of Queen Anne; the conquest of Wales; the union of Scotland; the union of Ireland.
2. What alterations were introduced into the administration of this country by the Normans?
3. Explain the dispute as to the right of investiture, in which William II. was involved.
4. Give a brief account of the objects of the dispute between Henry II. and Thomas à Becket.
5. Mention the principal clauses in Magna Charta.
6. What was the origin of the House of Commons? Show briefly what privileges it wrested successively from the sovereign, from its commencement to the reign of Henry VI.
7. What is meant by "The Royal Supremacy?" By whom was it first asserted? What did the kings of the Stuart line mean by the expression "The Royal prerogative?" How did the assertion of it bring out the opposite principle? When was it superseded?
8. State briefly what definite advantages were gained by Parliament for constitutional liberty, between 1625 and 1700.
9. Explain the purport of the two Acts of Settlement.
10. When did the party names of Whig and Tory arise? What is their origin? What names did they displace?
11. What was implied by the terms Jacobite, Non-juror, Pretender? When did these names spring up, and when did they disappear?
- *12. What were the effects of the French Revolution:—
 - (1.) On the two great political parties in England?
 - (2.) On the social condition of the lower classes here?
- *13. What great changes have taken place in the industrial occupations of the working classes, in the 19th, as compared with the previous century? What have been the moral and social effects of such changes?

SPECIAL SUBJECTS.

. The first and second, or first and third, of these subjects to be answered, but not more.

1. The battle of Bouvines. The parties engaged in it, and its consequences.
2. A brief account of some of the more eminent men who flourished in the reign of Henry III.
3. An account of the controversy between Henry III. and his barons.

ENGLISH LITERATURE.

THREE HOURS ALLOWED FOR THE TWO AUTHORS SELECTED BY THE CANDIDATE.

CHAUCER.

(Prologue to the "Canterbury Tales.")

SECTION I.

1. Ful worthi was he in his lorde's werre,
And thereto hadde he riden, noman ferre,
As well in Christendom as in hethenesse,
And evere honoured for his worthinesse.
At Alisandre he was whan it was wonne,
Ful ofte time he hadde the bord bygonne,
Aboven alle nacions in Pruce.
In Lettowe hadde he reyched and in Ruce,
No christen man so oft of his degre.

* Only one of these questions is to be answered.

In Gernade atte siege hadde he be
Of Algesir, and riden in Belmarie.
At Lieys was he, and at Satalie,
When they were wonne; and in the Greete see
At many a noble arive hadde he be.
At mortal batailles had he been fitene,
And foughten for our feith at Tramassene
In lystes thries and aye slayn his foo.

(a.) Write out the sense of this passage in modern English prose, keeping as closely as you well can to the original.

(b.) Explain the allusions.

(c.) Give a list of all the words which must be pronounced or accented differently from modern usage in order to preserve the versification.

2. Explain the following words:—*altherbest, lazar, vernicle, forby, thestat, tharray, tailles, solempne, ywrought, forpynded, ypiked, swinke*.

3. Explain these passages:—

Wel cowde he fortune the ascendent
Of his images for his pacient.

He rood upon a rouncy, as he couthe,
In a gowne of faldying to the kne,
A dagger hangyng on a laas hadde he.

In alle the orders foure is noon that can
So moche of daliaunce and fair langage.

4. Mention some of the grammatical constructions frequently used by Chaucer which have become obsolete.

SECTION II.

5. Describe either the Prioress, or the Clerk of Oxenford, as nearly as you can in the words of Chaucer.

6. What do you know of the shrine of Becket?

7. Give a short account of the pilgrimage to Canterbury as described by Chaucer.

8. Briefly sketch the life of Chaucer, and notice some of his most distinguished contemporaries.

SHAKESPEARE.

("King Lear"—"Richard III."—"As you like it.")

SECTION I.

(a.) Tut, I can counterfeit the deep tragedian;
Speak, and look back, and pry on every side,
Tremble and start at wagging of a straw,
Intending deep suspicion: ghastly looks
Are at my service, like enforced smiles;
And both are ready in their offices,
At any time, to grace my stratagems.

(b.) You touched my vein at first; the thorny point
Of bare distress hath ta'en from me the show
Of smooth civility: yet I am inland bred,
And know some nurture.

(c.) Jocky of Norfolk, be not so bold,
For Dickon thy master is bought and sold.

(d.) O reason not the deed: our basest beggars
Are in the poorest things superfluous.

(e.) That Julius Cæsar was a famous man:
With what his valour did enrich his wit,
His wit set down to make his valour live:
Death makes no conquest of this conqueror;
For now he lives in fame, though not in life.

(f.) When others are more wicked, not being the worst
Stands in some rank of praise.

(g.) Why, 'tis a boisterous and a cruel style,
A style for challengers; why, she defies me,
Like Turk to Christian.

(h.) Mine enemy's dog,
Though he had bit me, should have stood that night
Against the fire.

1. In what connexion does each of these passages occur?

2. Notice every peculiar grammatical construction, and every word employed in an unusual sense.

3. Give such explanatory notes, referring to the subject matter, as may seem to be required.

SECTION II.

4. Sketch the character either of King Lear or of Jaques.

5. Compare the characters of Buckingham and King Richard III.

6. Give an account of the plot of the first act of Richard III.

7. What do you know of the sources to which Shakespeare appears to have been indebted in constructing the plots of these three plays?

8. Give some account of the early editions of Shakespeare's plays.

BACON.

(The Essays.)

1. Give an outline of the essay, "Of Unity in Religion," or of that "Of Envy."

2. Explain the following passages, noticing anything peculiar in the words or grammatical construction:—

(a.) An ant is a wise creature for itself; but it is a shrewd thing, in an orchard, or garden.

(b.) Nay you shall see a bold fellow, many times, doe Mahomet's miracle.

(c.) The part of Epimetheus might well become Prometheus in the case of discontentments.

(d.) Virtue was never so beholden to human nature as it received its due at the second hand.

3. In what sense does Bacon use the following words:—*arietation, galliard, habitation, monoculos, commodities, colour, fallaxes, propriety, quidditie, privado, success, mew*.

4. Explain this passage, and illustrate it by examples:—"Some books are to be tasted, others to be swallowed, and some few to be chewed and digested."

5. Explain this passage, and give a sketch of the argument which Bacon founds upon it:—"Men's thoughts are much according to their inclination: their discourse and speeches according to their learning and infused opinions; but their deeds are often as they have been accustomed."

SECTION II.

6. What does Bacon say respecting the first publication of the Essays in "The Epistle Dedicatorie?"

7. Give a short account of Bacon's life after he became Lord Chancellor.

8. What do you know of the Novum Organon?

TRENCH.

[On the Study of Words.]

1. What argument is drawn from the following passage:—"Whatsoever Adam called every living creature, that was the name thereof," Gen. II., 19.

2. Words are said to be "the guardians of thought;" explain this and illustrate it by examples.

3. In what great particulars does the English language bear witness to the facts of our history?

4. Give examples of mistakes being embodied in names.

5. In what sense are names said to outlive things? Illustrate your answer by examples.

6. Explain these words:—*roué, mob, miscreant, talent, mammet, humanity, lumber, trivial, stipulation, cicerone, churl, surname*.

7. What is a synonym? Distinguish between *contrary* and *opposite*—*congratulate* and *felicitate*—*imagination* and *fancy*—*genuine* and *authentic*—*comprehend* and *apprehend*—*diffidence* and *despair*.

8. Explain the statement that there is poetry in words.

LOGIC AND MENTAL SCIENCE.

THREE HOURS ALLOWED.

FORMAL LOGIC.

1. What is the *Universal Principle of Reasoning*? How is it expressed by Aristotle? Explain and illustrate its meaning.

2. The conclusion of every syllogism is given in the premises. What argument has been founded against the utility of logic on this fact? How would you meet it?

3. What is meant by "*a term*" in logic? Many different kinds of terms have been enumerated by logicians; mention and explain the most important of these.

4. When are propositions said to be *opposed*? Explain the different kinds of opposition and give the rules of each?

6. What is meant by "*mood*," and what is meant by "*figure*?" For what kinds of arguments are the first, second, and third figures respectively best adapted, and why?

6. What general rules of the syllogism are violated in the following examples?—

Some literary men have been banished,
Some kings have been literary men,
Some kings have been banished.
Men are not feathered animals,
Eagles are not men,
Eagles are not feathered animals.
Many kings have been poets,
Many poets have been insane,
Some kings have been insane.

7. What is the classification of fallacies adopted by Whately? Explain the meaning of each class.

8. What is meant by the following terms employed to designate fallacies:—Homonymia, Amphibolia, Ignoratio elenchi, Petitio principii, Fallacia accidentis, Fallacia consequentis?

9. Analyse the following examples of reasoning and point out the *fallacies* contained in them:—

The French are a light-hearted people,
This man is a Frenchman,
Therefore he is light-hearted.
What I am you are not,
I am a man,
You are not a man.
All men are mortal,
Balbus is immortal,
Therefore Balbus is not a man.

LOGIC OF INDUCTION.

Mill's Logic.

1. Define induction.

2. Mention some operations said to be cases of induction which are not really so.

3. What axiom lies at the basis of all *pure* inductive reasoning?

4. What is the exact meaning which Mill attaches to the term "*Laws of Nature*?"

5. Give a brief sketch of Mill's analysis of the Law of Causation.

6. What is *observation*, and what is *experiment*? In what respect is the latter superior to the former as an instrument of research?

7. In determining a natural law, what is meant by the method of *agreement*, and what by the method of *difference*? Which affords the strongest evidence, and why?

8. What is meant by the *explanation* of natural laws? Give instances from the history of physical science?

9. What are empirical laws, and of what value are they in science?

MENTAL PHILOSOPHY.

Sir W. Hamilton's Lectures.

1. What is philosophy? How did it originate, and under what conditions must it be pursued?

2. Explain Hamilton's doctrine of the "*Relativity of Human Knowledge*."

3. What is expressed *generally* by the word *consciousness*? Is it one of the mental faculties?

4. Give Hamilton's classification of theories which have been formed respecting our knowledge of the external world.

5. Give Hamilton's classification of the *cognitive* faculties, and show exactly what he intends to include under each head.

6. Show the distinction between sensation proper and perception proper, and their relation to each other.

8. What is Hamilton's theory of perception, and to what other celebrated theory is it opposed?

8. Explain the "*law of the conditioned*" as the great fundamental fact of man's regulative faculty, and point out any of its applications.

MENTAL PHILOSOPHY.

Brown's Lectures.

1. How does Brown show the fundamental unity of physical and mental science?

2. Give some account of the physical processes in sensation.

3. What mental phenomena are usually ascribed to the sense of touch? Give an outline of Brown's criticism on this point.

4. In what respect does Brown differ from Reid on the subject of *perception*? Give the principal points of his polemic against the latter.

5. Explain Brown's theory of *attention*.

6. What are the *primary* and what the *secondary* laws of suggestion? Enumerate them.

7. Which of the faculties does Brown reduce to cases of simple suggestion, and which to cases of relative suggestion? Explain the method of this analysis.

8. Make a table showing Brown's classification of mental phenomena.

MORAL PHILOSOPHY.

Sir J. Mackintosh.

1. Into what two main inquiries may the whole of ethical philosophy be divided? How have those two inquiries been confused?

2. Name some of the ancient schools of morals with their leading tenets.

3. Mention the most remarkable English writers who have advocated *utilitarianism*, and show in what *form* they have advocated it.

4. What different views have been held in England by ethical writers on the nature of conscience?

5. What are the leading ideas of Adam Smith's theory of modern sentiments?

6. What great principle was introduced by Hartley into the study of mental and moral philosophy? How did he apply it to morals?

7. How does Mackintosh attempt to mediate between opposite systems of moral philosophy?

MORAL PHILOSOPHY.

Fleming's Manual.

1. Explain the difference between principles of knowledge and principles of action.

2. How may the primary principles of human action be classified? In what way may they be modified?

3. Explain the two main theories which have been held by ethical writers concerning the nature of conscience.

4. Mention the *special views* of some of our most celebrated moralists on this subject.

5. Explain the fundamental theories which have been held on the nature of virtue. What ethical doctrines are included under each?

6. What celebrated writers have advocated the principle of *benevolence* and the principle of *utility* respectively as the ground of morals.

7. Explain the theory of morals advocated by Dr. Fleming in his manual.

LATIN AND ROMAN HISTORY.

THREE HOURS ALLOWED.

SECTION I.

Translate:—

Sin autem ad pugnam exierint—nam saepe duobus Regibus incessit magno discordia motu; Continuoque animos vulgi et trepidantia bello Corda licet longe praesciscere; namque morantes Martius ille aeris rauci canor increpat, et vox Auditur fractos sonitus imitata tubarum; Tum trepidae inter se coeunt pennisque coruscant, Spiculaque exacuunt rostris, aptantque lacertos, Et circa regem atque ipsa praetoria densae Miscentur, magnisque vocant clamoribus hostem; Ergo ubi, ver nactae sudum camposque patentis, Erumpunt portis, concurrunt, aethere in alto Fit sonitus, magnum mixtae glomerantur in orbem, Praecipitesque cadunt—non densior aëre grando, Nec de concussa tantum pluit illice glandis.

1. Parse fully, giving both syntax and accident, the words *regibus, corda, sonitus, rostris, concurrunt, glandis*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *praesciscere, fractos, miscentur, nactae, erumpunt, cadunt*.

SECTION II.

Ipsa ego te, medios quum sol accenderit aestus, Quum sitiunt herbae et pecori jam gratior umbra est In secreta senis ducam, quo fessus ab undis Se recipit, facile ut somno aggrediare jacentem. Verum ubi correptum manibus vinculisque tenebis, Tum variae eludent species atque ora ferarum: Fiet enim subito sus horridus atraque tigris Squamosusque draco et fulva cervice leaena, Aut acrem flammae sonitum dabit atque ita vinculis Excidet, aut in aquas tenues dilapsus abibit. Sed quanto ille magis formas se vertet in omnes, Tanto, nate, magis contendit tenacia vincla, Donec talis erit mutato corpore, qualem Videris, incepto tegeret quum lumina somno.

1. Parse fully, giving both syntax and accident, the words *pecori, senis, somno, correptum, cervice, corpore*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *ducam, aggrediare, dabit, dilapsus, contendit, videris*.

SECTION III.

Translate:—

Tum Sabinae mulieres, quarum ex injuria bellum ortum erat, crinibus passis scissaque veste victo malis muliebri pavore ausae se inter tela volantia inferre, ex transverso impetu facto dirimere infestas acies, dirimere iras, hinc patres hinc viros orantes, ne se sanguine nefando soceri generique respergerent, ne parricidio macularent partus suos, nepotum illi, hi liberum progeniem. "Si adfinitatis inter vos, si conubii piget, in nos vertite iras. nos causa belli, nos vulnere ac caedium viris ac parentibus sumus. melius peribimus quam sine alteris vestrum viduae aut orbae vivemus." movet res cum multitudinem tum duces. silentium duces repentina fit quies; inde ad foedus faciendum duces prodeunt, nec pacem modo sed civitatem unam ex duabus faciunt, regnum consociant, imperium omne conferunt Roman.

1. Parse fully, giving both syntax and accident, the words *crinibus, acies, sanguine, nepotum, vulnere, civitatem*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *inferre, respergerent, movet, prodeunt*.

3. Explain why *respergerent* is in the subjunctive mood and imperfect tense.

SECTION IV.

Translate:—

Tum vero in dies infestior Tulli senectus, infestius coepit regnum esse. jam enim ab scelere ad aliud spectare mulier scelus, nec nocte nec interdiu virum con-

quiescere pati, ne gratuita praeterita parricidia essent: non sibi defuisse, cui nupta diceretur, nec cum quo tacita serviret; defuisse, qui se regno dignum putaret, qui meminisset se esse Prisci Tarquini filium, qui habere quam sperare regnum mallet. "Si tu is es, cui nuptam esse me arbitror, et virum et regem appello: sin minus, eo nunc pejus mutata res est, quod istic cum ignavia est scelus. quin accingeris? non tibi ab Corintho nec ab Tarquiniis, ut patri tuo, peregrina regna moliri necesse est; di te penates patrique et patris imago et domus regia et in domo regale solium et nomen Tarquinius creat vocatque regem. aut si ad haec parum est animi, quid frustraris civitatem? quid te ut regium juvenem conspici sinis? facesse hinc Tarquinius aut Corinthum, devolvere retro ad stirpem, fratris similior quam patris.

1. Parse fully, giving both syntax and accident, the words, *scelere, sibi, regno, penates, animi, Tarquinius*.

2. Give the present and perfect tenses indicative active and the supines of the verbs *diceretur, accingeris, conspiciet, facesse*.

3. Explain why *serviret* is in the subjunctive mood, and why *defuisse* in the infinitive.

SECTION V.

1. Describe the office of Prætor. When was the office instituted, and when opened to the plebeians?

2. Give an account of the first Latin league.

3. Why was the Tribunate instituted, and what were its powers and privileges?

4. Write a short history of Cincinnatus.

5. When did Rome become a maritime power? Give an account of her naval successes.

6. Give an account of the first Punic war.

SECTION VI.

1. When did Rome first come into contact with Greece, and by what steps was she led on to the conquest of that country?

2. Give an account of Cicero.

3. Give an account of the Social War.

4. On what occasions was the Roman State in very great danger? and how was it saved?

5. Write a short history of Pompey.

6. What was the treaty of Brundisium? what were its results?

FRENCH.

THREE HOURS ALLOWED.

PART I.

Candidates for a third-class certificate are requested to translate into English the two following extracts, and to answer the grammatical questions thereto annexed, in the order in which they are placed. This first part is all that will be expected of them.

Translate:—

Il y avait du temps de François 1^{er} un brave paysan du Périgord, qui s'appelait Bernard Palissy. Dans ce temps-là, n'avait pas des assiettes de faïence qui voulait. C'était une fabrication dont les Italiens seuls possédaient le secret, et Bernard, qui savait déjà quelque chose en sa qualité d'ouvrier verrier, se mit en tête de le découvrir à lui tout seul. Le voilà donc qui se fait potier sans demander conseil à personne, qui bâtit des fours, ramasse du bois comme il peut, fabrique ses premiers pots tant bien que mal, allume son feu, enfourne, et attend. Il en eut pour 15 à 16 ans avant de réussir, 15 à 16 ans d'essais ruineux qui auraient découragé un grand seigneur. Mais lui, dès qu'il avait pu ramasser quelque argent avec ses vitraux, il retournait à son œuvre avec une persévérance indomptable, insensible à la misère, sourd aux moqueries des voisins, inébranlable aux malédictions de sa femme, qui était furieuse, comme bien vous pensez, de faire avec lui de l'héroïsme, sans en avoir la moindre envie. Or, un beau jour, voilà une grande rumeur à La Chapelle-Biron: c'était son village. "Bernard est devenu fou," disaient

les gens ; "il brûle sa maison pour faire cuire ses pots !" Et c'était, ma foi, la vérité. Le bois étant venu à manquer, pendant qu'une fournée était au feu, Bernard avait commencé par prendre la palissade du jardin, puis les grosses tables, puis enfin le plancher de la maison. Ce que pouvait dire la femme, je vous le laisse à juger ; mais lui n'écoutait rien, et les yeux fixés sur l'implacable fourneau, comme un soldat sur sa consigne, il jetait et jetait, ne pensant qu'à son œuvre en danger. Le plafond aurait suivi le plancher, si les pots n'avaient fini par se cuire à point.—Jean Macé, *Histoire d'une Bouchée de Pain*.

And also:—

Un jour que de l'Etat le vaisseau séculaire
Fatigué trop long-temps du roulis populaire,
Ouvert de toutes parts, à demi dématé,
Sur une mer d'écueils, sous des cieux sans étoiles,
Au vent de la Terreur qui déchirait ses voiles,
S'en allait échouer la jeune Liberté ;
Tous les rois de l'Europe, attentifs au naufrage,
Tremblèrent que la masse, en heurtant leur rivage,
Ne mît du même choc les trônes au néant ;
Alors, comme forbans qui guettent une proie,
On les vit tous s'abattre avec des cris de joie,
Sur les flancs dégarnis du colosse flottant.
Mais lui, tout mutilé des coups de la tempête,
Se dressa sur sa quille, et relevant la tête,
Hérissa ses sabords d'un peuple de héros,
Et rallumant soudain ses foudres désarmées,
Comme un coup de canon lâcha quatorze armées,
Et l'Europe à l'instant rentra dans son repos.

A. Barbier, *Iambes*.

1. Give the five primitive tenses of each of the following verbs which occur in the above extracts:—*voulait, savait, se mit, se fait, bâtit, peut, attend, est devenue, disaient, cuire, prendre, aurait suivi, ouvert, vit, s'abattre*.

2. Explain the meaning of *brave* as used in the first sentence of the first extract. Show also the difference between *un grand homme* and *un homme grand*.

3. Name the nominative case of the verb *avait*, in the second sentence of the same extract:—"Dans ce temps là," &c.

4. What is the singular of *vitraux*? Give also the singular of the substantive *bauz*.

5. "*De l'héroïsme*." Is the *h* silent or aspirated in *héros*, *héroïne*, and *héroïque*? Explain, in reference to this question, the exact nature of the aspirated *h* in French.

6. "*Les yeux fixés sur, &c.*," (last line but three of the first extract). Why not *ses yeux*? Give the rule.

7. Explain the word *ne* which begins the 9th line of the second extract. Can you give other instances of a similar construction?

8. Give, with examples taken from the second extract, the different meanings and constructions of the preposition *de*.

9. Parse the first six lines of the second extract.

10. "*Il en eut pour 15 à 16 ans, &c.*" When are you to render 15 or 16 by 15 *ou* 16, when by 15 *à* 16?

11. Give the different meanings, with a corresponding difference in the gender, of the words: *crêpe, hymne, mémoire, mousse, poêle, tour, voile*.

12. Write in full:—Page 300 ; 220 hommes ; l'an 1500 ; 85 volumes ; chapitre 80 ; 500 chevaux.

13. Explain the grammatical difference between *chaque* and *chacun* ; between *notre*, *votre*, and *le nôtre*, *le vôtre* ; between *quelconque* and *quiconque* ; and between *quelque* and *quel que*.

14. Translate and explain the following words:—*crû, créu ; creuse ; cours, court ; eu, eux ; font, fonts ; las ; les ; lui ; lus ; mets, mes ; mis ; mors, mort ; ris, riz ; va ; vis ; vive ; vu*.

PART II.

Candidates for a second-class certificate are to answer the last three questions in Part I., together with those in Part II., and to translate the English extract and idiomatic expressions which follow:—

1. How do you convey in French the emphasis or

contradistinction implied in each of the following sentences?

He may think so, but I do not.

You will injure yourself, not him.

Your ways are not my ways.

A la guerre comme à la guerre, as we Frenchmen say.

2. Being given these two sentences:—*They made him drink ; they made him drink some wine ;* the pronoun "*him*" will be rendered by a different case in each sentence. Explain this peculiar rule, and name the other verb, besides *faire*, to which it applies.

3. Which are the words that are always accompanied by the pronoun *en*, when they are the "object" of the verb, and the noun to which they refer is not expressed at the same time?

4. In what particular sense is the word *autrui* used to express another or others?

5. Give the adjective that corresponds to each of the following nouns:—*Ciel, terre, mer, an, trimestre, mois, semaine, jour, siècle, moine, église, évêque, matin, nuit, tête, os, muscle, nerf, sang, vie, ail, oreille, nez, bouche, poil, graisse, huile, fer, bitume, eau, pain, air, travail, sécheresse, secret, calme, apathie, énergie, santé, vol*.

6. Distinguish between "*C'est à lui à parler*" and "*c'est à lui de parler*," and also between "*Il impose*" and "*Il en impose*."

Translation:—

A friend of Dean Swift one day sent him a turbot as a present by a servant lad who had frequently been on similar errands, but who had never received the most trifling mark of the Dean's generosity. Having gained admission, he opened the door of the study, and abruptly putting down the fish, cried very rudely, "Master has sent you a turbot." "Young man," said the Dean, rising from his easy chair, "is that the way you deliver your message? Let me teach you better manners; sit down in my chair; we will change situations, and I will show you how to behave in future." The boy sat down, and the Dean, going to the door, came up to the table with a respectful pace, and making a low bow, said, "Sir, my master presents his kind compliments, hopes you are well, and requests your acceptance of a small present." "Does he?" replied the boy; "return him my best thanks, and there's half-a-crown for yourself." The Dean, thus drawn into an act of generosity, laughed heartily, and gave the boy a crown for his wit.

Idioms:—

1. On lui a donné du fil à retordre.

2. J'ai pensé coucher à la belle étoile.

3. Envoyez-les donc promener une fois pour toutes.

4. Vous avez fait là un pas de clerc.

5. Ne vous y fiez pas; il n'est pire eau que celle qui dort.

6. Ne vous laissez pas prendre à ses airs de sainte-n'y touche.

7. C'est un homme tout rond qui n'y va pas par quatre chemins.

8. Je vous le dis en bon français, cela ne me va pas du tout.

9. Il fait le bon apôtre, mais je sais à quoi m'en tenir.

10. Touchez là, et qu'il n'en soit plus question.

11. Il fallait voir comme ils s'en sont donné à cœur-joie!

12. Les pauvres gens, ils auront bientôt repris le collier de misère.

PART III.

Candidates for a first-class certificate are expected to translate the above idioms and English extract, and to answer in French the grammatical questions Nos. 1, 3, and 5, in Part II., as also the following:—

Literature.—1. Show the influence exercised upon their age, in and out of France, by the great literary men of the 18th century, and more especially by Voltaire and Montesquieu.

2. Name the principal works of J. J. Rousseau, Hel-

vétius, Diderot, D'Alembert, Le Sage, Raynal, Buffon, Condillac, Vertot, Bernardin de St. Pierre, Volney, Beaumarchais, and Condorcet. Give a, short critical account of any one of those works.

History.—Explain some of the most ostensible causes which brought about the Great Revolution of 1789.

GERMAN.

THREE HOURS ALLOWED.

Each candidate is expected to translate one of the passages of Section I., to answer four of the questions of Section II., and to turn into German twelve of the sentences given in Section III. Candidates for a first Class must translate one piece of Section I., answer (e), (f), and (g) of Section II.; render into German 17–20 inclusive, of Section III.; give answers to the questions on the history and literature of Germany, and write out in German the essay.

SECTION I.

1. Heinrich von Brederode, Herr von Viane und Burggraf von Utrecht, leitete seinen Ursprung von den alten holländischen Grafen ab, welche diese Provinz ehemals als souveräne Fürsten beherrscht hatten. Ein so wichtiger Titel machte ihn einem Volke theuer, unter welchem das Andenken seiner vormaligen Herren noch unvergessen lebte, und um so werther gehalten wurde, je weniger man bei der Veränderung gewonnen zu haben fühlte. Dieser angeerbte Glanz kam dem Eigendünkel eines Mannes zu statten, der den Ruhm seiner Vorfahren stets auf der Zunge trug, und um so lieber unter den verfallenen Trümmern der vorigen Herrlichkeit wandelte, je trostloser der Blick war, den er auf seinen jetzigen Zustand warf. Von allen Würden und Bedienungen ausgeschlossen, wozu ihm die hohe Meinung von sich selbst, und der Adel seines Geschlechts einen begründeten Anspruch zu geben schien (eine Schwadron leichter Reiter war Alles, was man ihm anvertraute), hasste er die Regierung, und erlaubte sich, ihre Massregeln mit verwegenen Schmähungen anzugreifen. Dadurch gewann er sich das Volk. Auch er begünstigte im Stillen das evangelische Bekenntnis.

2. Der König ritt herab vom Stein zu Baden Gen Rheinfeld, wo die Hofstatt war, zu ziehn, Mit ihm die Fürsten Hans und Leopold Und ein Gefolge hochgeborner Herren. Und, als sie kamen an die Reuss, wo man Auf einer Fähre sich lässt übersetzen, Da drängten sich die Mörder in das Schiff, Dass sie den Kai' er vom Gefolge trennten. Drauf, als der Fürst durch ein geackert Feld Hinreitet—eine alte grosse Stadt Soll drunter liegen aus der Heidenzeit— Die alte Veste Habsburg im Gesicht, Wo seines Stammes Hoheit ausgegangen— Stösst Herzog Hans den Dolch ihm in die Kehle, Rudolph von Palm durchrennt ihn mit dem Speer, Und Eschenbach zerspaltet ihm das Haupt, Dass er heruntersinkt in seinem Blut. Gemordet von den Seinen auf dem Seinen.

3. Ein edler Mensch zieht edle Menschen an, Und weiss sie festzuhalten, wie ihr thut. Um deinen Bruder und um dich verbinden Gemüther sich, die euer würdig sind, Und ihr seid eurer grossen Väter werth. Hier zündete sich froh das schöne Licht Der Wissenschaft, des freien Denkens an, Als noch die Barbarei mit schwerer Dämmung Die Welt umher verbarg. Mir klang als Kind Der Name Hercules von Este schon, Schon Hippolyt von Este voll ins Ohr. Ferrara ward mit Rom und mit Florenz Von meinem Vater viel gepriesen! Oft Hab' ich mich hingesehnt; nun bin ich da.

* * * * *

Italien nennt keinen grossen Namen,

Den dieses Haus nicht seinen Gast genannt. Und es ist vortheilhaft den Genius Bewirthen; giebst du ihm ein Gastgeschenk, So lässt er dir ein schöneres zurück. Die Stätte, die ein guter Mensch betrat, Ist eingeweiht; nach hundert Jahren klingt Sein Wort und seine That dem Enkel wieder.

5. Heinrich III. ist auch unter den Kaisern zu nennen, welche die eigne Bildung durch Liebe zu den Wissenschaften, durch Gunst gegen ausgezeichnete Männer, und durch Förderung der Bildung im Allgemeinen bewiesen haben. Die Aufforderung des Lebensbeschreibers seines Vaters, Wippo, in einem eigenen an ihn gerichteten lateinischen Gedichte, dass er auch die Kinder der weltlichen Grossen in den Wissenschaften unterrichten lassen möge, hat er durch Sorge für die Schulen eifrig in Erfüllung gebracht. Es blühten unter ihm vorzüglich die Schulen zu Lüttich, Lobbes, Gemblours, Fulda, Paderborn, St. Gallen, Reichenau u. a. In den beiden zuletztgenannten Schulen bildete sich einer der grössten Gelehrten der damaligen Zeit, Hermann der Contracte, von Jugend auf so gelähmt, dass er nur mit grosser Mühe schreiben konnte, ja so schwer mit der Zunge, dass seine Schüler erst langsam ihn verstehen lernten, und doch so gesucht und geehrt von ihnen, dass sie aus allen Ländern zu ihm strömten.

SECTION II.—GRAMMAR AND IDIOMS.

(a.) Form diminutives of *Garten, Knabe, Haus, Buch, Strauss, Krug*.

(b.) State gender, number, and case of the following substantives:—*des Bösen, Ländern, der Frauen, der Bande, Geiste, der Mütter*.

(c.) Form the comparative and superlative of *gern, hart, viel, gross, nahe*.

(d.) Decline in every case, singular and plural, the German of:—New book; this high house; his older table.

(e.) When do neuter verbs take *haben* and when *sein* as auxiliary verbs? Illustrate the rule by two examples for each auxiliary.

(f.) Conjugate the present and imperfect of *hauen, stehlen, werfen, singen, wissen*, and add the participle past of each.

(g.) Was soll das heissen?

Was gilt's?

Bekümmern Sie sich um sich.

Er lässt viel drauf gehen.

Er hat alles aufs Spiel gesetzt.

An wem ist nun die Reihe?

Wie ist er denn dahinter gekommen?

Ich kehre mich nicht daran.

Das ist ganz und gar aus der Luft gegriffen.

Es wird auch nicht viel darauf ankommen.

Das wird noch recht übel ablaufen.

Sie stacken alle unter einer Decke.

SECTION III.

[The writing, either in English or German characters, must be very legible.]

1. I bought three yards and a half of ribbon.
2. Many people have arrived in town.
3. Twelve times twelve are one hundred and forty-four.
4. It is a quarter to nine by my watch.
5. We who came yesterday had the advantage.
6. I have had a pair of boots made.
7. I have not been able to see you.
8. He who talks much does little.
9. With great anxiety they were waiting for him.
10. The table was ten feet long and five feet wide.
11. When you come again to our neighbourhood, you must call in.
12. Do write to us as soon as you can.
13. I would give all the treasures of the world for it.
14. Do you see that black and white horse?
15. Had I your money, I should travel to Italy.
16. Would that I had done everything well!

17. Do you believe him to be honest ?

18. They are dear friends of ours.

19. One of my books had fallen under the table.

20. Till Clive appeared in India, his countrymen were despised as mere pedlars, while the French were revered as a people formed for victory and command. His courage and capacity dissolved the charm. With the defence of Arcot commences that long series of Oriental triumphs which closes with the fall of Ghizni. Nor must we forget that he was only twenty-five years old when he approved himself ripe for military command. This is a rare if not a singular distinction. It is true that Alexander, Condé, and Charles the Twelfth won great battles at a still earlier age; but those princes were surrounded by veteran generals of distinguished skill. Clive, an inexperienced youth, had yet more experience than any who served under him. He had to form himself, to form his officers, and to form his army. The only man, as far as we recollect, who at an equally early age ever gave equal proof of talents for war, was Napoleon Bonaparte.

QUESTIONS ON GERMAN HISTORY AND LITERATURE.

(a.) Which are the most renowned emperors of the Saxon and Hohenstaufen house ?

(b.) When and under whom was the first crusade undertaken ?

(c.) What struggles had Frederic I. to contend with ? How, when, and where did he die ?

(d.) State what you know about Hans Sachs and his works ?

(e.) Who is the great satirist in the sixteenth century ?

(f.) Name the principal *Volksbücher*.

Write in German a short essay on "The blessings of peace."

ITALIAN.

THREE HOURS ALLOWED.

Candidates for a first-class certificate must translate the following passage, and answer the grammatical questions based on it:—

1. Quando noi fummo fatti tanto avante,
Ch'al mio maestro piacque di mostrarmi
La creatura, ch'ebbe il bel sembiante,
Dinanzi mi si tolse, e fe restarmi,
Ecco Dite, dicendo, ed ecco il loco,
Ove convien che di fortezza t'armi.
Com' i' divenni allor gelato e fioco,
Nol dimandar, Lettor, ch' i' non lo scrivo,
Però ch' ogni parlar sarebbe poco.
I' non morì, e non rimasi vivo:
Pensa oramai per te, s'hai fior d'ingegno,
Qual'io divenni, d'uno e d'altro privo.
Lo 'mperador del doloroso regno
Da mezzo 'l petto uscì fuor della ghiaccia:
E più con un gigante i' mi convegno,
Che i giganti non fan con le sue braccia:
Vedi oggimai, quant' esser dee quel tutto,
Ch' a così fatta parte si confaccia.
S' ei fu sì bel, com' egli è ora brutto,
E contra 'l suo fattore alzò le ciglia,
Ben dee da lui procedere ogni lutto.
O quanto parve a me gran meraviglia,
Quando vidi tre facce alla sua testa!
L'una dinanzi, e quella era vermiglia:
L'altre eran due, che s'aggiungéno a questa,
Sovr' esso 'l mezzo di ciascuna spalla,
E si giungéno al luogo della cresta:
E la destra pareva tra bianca e gialla;
La sinistra a vedere era tal, quali
Vengon di là, ove 'l Nilo s' avvala.
Sotto ciascuna uscivan duo grand' ali,
Quanto si conveniva a tutt' uccello:
Vele di mar non vid' io mai cotali.
Non avén penne, ma di vipistrello
Era lor modo: e quelle svolazzava,

Sì che tre venti si movén da ello:

Quindi Cocito tutto s' aggelava.

Dante, Canto XXXIV., Inferno.

Tolse: Give the two infinitive moods of this verb.

Fe: How is this word more generally written ?

Rimasi: Give the two participles past of this.

Uscì: Write the whole present tense of the indicative.

Dee: What are the other two forms of this person of the verb ?

Parve: Give the whole present tense of the indicative.

Aggiungéno: Is this the usual form of this word ? How should it be now otherwise written ?

2. Translate into Italian:—

The progress of elegant literature and of the fine arts was proportioned to that of the public prosperity. Under the despotic successors of Augustus, all the fields of the intellect had been turned into arid wastes, still marked out by formal boundaries, still retaining the traces of old cultivation, but yielding neither flowers nor fruit. The deluge of barbarism came. It swept away all the landmarks. It obliterated all the signs of former tillage. But it fertilized while it devastated. When it receded, the wilderness was as the garden of God, rejoicing on every side, laughing, clapping its hands, pouring forth in spontaneous abundance, everything brilliant, or fragrant, or nourishing. A new language, characterised by simple sweetness and simple energy, had attained perfection. No tongue ever furnished more gorgeous and vivid tints of poetry; nor was it long before a poet appeared who knew how to employ them. Early in the fourteenth century came forth the Divine Comedy, beyond comparison the greatest work of imagination which had appeared since the poems of Homer. The following generation produced, indeed, no second Dante; but it was eminently distinguished by general intellectual activity. The study of the Latin writers had never been wholly neglected in Italy. But Petrarch introduced a more profound, liberal, and elegant scholarship, and communicated to his countrymen that enthusiasm for the literature, the history, and the antiquities of Rome which divided his own heart with a frigid mistress and a more frigid Muse. Boccaccio turned their attention to the more sublime and graceful models of Greece.—(Macaulay's Essays.)

3. Italian idioms to be translated into their English equivalents:—

Ne corre voce.—Davvero non v'è da ridere.—Fatevi forza se volete riuscire.—Ebbe grido di galantuomo.—Me ne duole assai assai.—Non giovano le parole ci vogliono fatti.—Egli cammina a stento.—Stento a crederlo.—Lo trassi in disparte.—Non me n'avvidi.—Fatevi in qua.—Questa non è da voi.—Così si tratta co' pari vostri.—Si vuole che sia partito.

Candidates for second or third-class certificates are required (1) to translate into English the following extracts, and (2) to answer the grammatical questions given below.

Federigo Borromeo, nato nel 1564, fu degli uomini rari in qualunque tempo, che abbiano impiegato un ingegno egregio, tutti i mezzi d'una grande opulenza, tutti i vantaggi di una condizione privilegiata, un intento continuo nella ricerca e nell'esercizio del meglio. La sua vita è come un ruscello che spiccato limpido dalla roccia, senza ristagnar nè intorbidirsi mai in un lungo corso per diversi terreni, va limpido a gittarsi nel fiume. Tra gli agi e le pompe, egli badò fin dalla puerizia a quelle parole di abnegazione e di umiltà, a quelle massime intorno alla vanità dei piaceri, all'ingiustizia dell'orgoglio; alla vera dignità e ai veri beni, che, sentite o non sentite nei cuori, vengono trasmesse da una generazione all'altra nel più elementare insegnamento della religione. Badò, dico, a quelle parole, a quelle massime, le pigliò in sul serio, le gustò, le trovò vere: comprese che dunque non potevano essere vere altre parole ed altre massime opposte, che pur si trasmettono d'età in età, colla stessa asseveranza, e

talvolta dalle stesse labbra; e propose di prender per norma delle azioni e dei pensieri quelle che erano il vero. Per esse intese che la vita non è già destinata ad essere un peso per molti, e una festa per alcuni; ma per tutti un impiego, del quale ognuno renderà conto: e cominciò fanciullo a pensare come potesse render la sua utile e santa.

"Pur troppo!" disse Federigo, "tale è la misera e terribile nostra condizione. Dobbiamo esigere rigorosamente dagli altri quello che Dio sa se noi saremmo pronti a dare: dobbiamo giudicare, correggere, riprendere; e Dio sa quel che noi faremmo, nel caso stesso, quello che abbiamo fatto in casi somiglianti! Ma guai, s' io avessi da pigliar la mia debolezza per misura del dovere altrui, per norma del mio insegnamento. Pure, è certo che, con le dottrine, io debbo dare altrui l' esempio, non rendermi simile al fariseo, che impone altrui importabili pesi, i quali egli non vuol pur toccare col dito. Or bene, figliuolo e fratello; poichè gli errori di quei che presiedono sono spesso più noti altrui che non a loro; se voi sapete che io abbia, per pusillanimità, per rispetto qualunque, trascurato qualche mio obbligo, ditemelo francamente, fatemi ravvedere; affinché, dove ha mancato l' esempio, sovvenga almeno la confessione. Dimostratemi liberamente le mie debolezze; e allora le parole acquisteranno più valore nella mia bocca, perchè sentirete più vivamente, che non son mie, che sono di Chi può dare a voi e a me la forza necessaria, per far ciò che prescrivono."—(Manzoni, I Promessi Sposi.)

GRAMMATICAL QUESTIONS.

1. Give the gender of nouns ending in *a* and in *o*, and the various exceptions to the rule in either termination.
2. Translate the following sentences, illustrative of comparatives and superlatives:—Better late than never.—The happiest of men.—Stronger than the lion.—She is as good as she is fair.—He is more learned than wise.—A very great danger.—We are less fortunate than you (are).—Light as a feather.
3. Explain the distinction of meaning between the demonstrative pronouns *quello* and *questo*.
4. Write the whole present tense of the indicative of *dire*; the imperfect of *trarre*; the preterite of *sapere*; the future of *volere*; the conditional of *rimanere*; the imperative of *andare*; the present of the subjunctive of *sentire*; the imperfect of *essere*; the participle past of *condurre*, *prendere*, *morire*, *scegliere*.

SPANISH.

THREE HOURS ALLOWED.

FIRST CLASS.

1. Render into Spanish the following passage:—

After Don Quixote had satisfied his hunger, he took up a handful of acorns, and, looking on them attentively, gave utterance to expressions like these:—"Happy times, and happy ages, were those which the ancients termed the golden age! not because gold, so prized in this our iron age, was to be obtained, in that fortunate period, without toil; but because they who then lived were ignorant of those two words, 'Mine and Thine.' In that blessed age, all things were in common to provide their ordinary sustenance; no other labour was necessary than to raise their hands and take it from the sturdy oaks, which stood liberally inviting them to taste their sweet and relishing fruit. The limpid fountains and running streams offered them, in magnificent abundance, their delicious and transparent waters. In the clefts of rocks, and in hollow trees, the industrious and provident bees formed their commonwealths, offering to every hand, without interest, the fertile produce of their most delicious toil. The stately cork-trees, impelled by their own courtesy alone, divested themselves of their light and expanded bark, with which men began to cover their houses, supported by rough poles only, as

a defence against the inclemency of the heavens. All then was peace, all amity, all concord. The heavy coulter of the crooked plough had not yet dared to force open and search into the tender bowels of our first mother, who, unconstrained, offered, from every part of her fertile and spacious bosom, whatever might feed, sustain, and delight those, her children, by whom she was then possessed."—*Cervantes*.

2. Translate into English the following:—

Mandarón á un estudiante yendo á cazar que no hablase porque espantaría á los conejos; y dijo cuando los vió, Ecce caniculi multi. Y como se espantasen y le rinesen, respondió:—? Quien habia de pensar que los conejos sabian latin?

En una almoneda de los bienes de un mercader que debia mucho dinero, uno compró un colchon diciendo, que era bueno para dormir, pues *dormia* en el, hombre que debia tanto.

El Marques de Cortés decia que él que carecia de amigos, era como panal sin miel, espiga sin trigo, ó árbol sin fruto.

3. Explain the following idioms and proverbs:—

Al primer tapon zurrapas:—

Puesto en cucullas.

El dar limosna, nunca mengua la bolsa.

El poco hablar es oro, y el mucho lodo.

El vino que es bueno, no ha menester pregonero.

En tu casa no tienes sardina, y en la agena pides galina.

SECOND CLASS.

1. Translate into English the following extract:—

Acabó su historia aquel ladrón, y comenzó otra la suya, diciendo que él era hijo de un mercader de Burgos, y que en su mocedad, llevado de una indiscreta devoción, habia tomado el hábito de cierta religion muy austera, de la cual habia apostatado algunos años despues. En fin, todos los ocho ladrones hablaron por su turno, y cuando, los hubo á todos oido, no me admiré de verlos juntos. Mudaron luego de conversacion y propusieron varios proyectos para la proxima campana, sobre los cuales tomaron su resolucion, y se fueron á la cama. Encendieron bujías, y cada uno se retiró á su cuarto. Yo seguí al capitan Rolando al suyo, y mientras le ayudaba á desnudar. Ahora bien, Gil Blas, me dijo, ya ves nuestro modo de vivir. Siempre estamos alegres. Entre nosotros no se dá lugar al tedio ni á la envidia. Jamás se oye aquí discordia ni disension estamos mas unidos que frailes. Tú comienzas ahora, hijo mio, á gozar una vida muy agradable, pues no té tengo por tan tonto que te dé pena el vivir entre ladrones.—*Le Sage*.

2. Point out the irregularities of the verbs *dormir* and *ir*.

3. Write the plural number of the following nouns:—*Baja*, *aleli*, *rondó*, *fistu*, *café*, *canapé*, *pié*, *maravedi*.

4. Do the words *caos*, *genesis*, *nada*, *infanteria*, *caballeria*, *egotismo*, *vandalismo*, admit of a plural?

5. Point out the gender of the following nouns:—*Planeta*, *sistema*, *sofisma*, *patriarca*, *sátrapa*, *tapaboca*, *poeta*.

THIRD CLASS.

1. Translate the half of the extract from "Gil Blas" (*Vide Q. 1, Second Class*).

2. Answer the grammatical questions (*Ibidem*).

3. Translate into Spanish the following phrases:—

Religion raises men above themselves; irreligion sinks them beneath the brutes: this binds them down to a poor pitiable speck of perishable earth; that opens for them a prospect to the skies.

Every person, whatever be his station, is bound by the duties of morality and religion.

We should implant in the minds of youth such seeds and principles of piety and virtue as are likely to take the deepest root.

FREE-HAND DRAWING.

THREE HOURS ALLOWED.

Candidates are not required to do more than one of the following subjects:—

1. Make a drawing of the time-piece as large as you can, on half a sheet of imperial paper.
2. Draw from knowledge the front view of a head looking up, and a head looking down, both the size of life.
3. Make a design illustrative of your occupation, and explain the subject in writing at the bottom of your drawing.

DIRECTIONS FOR THE LOCAL BOARDS.

Place a handsome time-piece on the chimney-piece of the room in which the candidates are to draw; or, if the chimney piece be in a dark or inconvenient part of the room, let the time-piece be raised on a table four feet from the ground.

GEOMETRICAL DRAWING.

THREE HOURS ALLOWED.

The constructions must be accurate, and show clearly, by plain and dotted lines, with appropriate letters of reference, the principles on which they are based. They may be put in ink or left in pencil, at the discretion of the candidate, provided they are distinct.

No deviation from the conditions of the questions can be admitted; and since no candidate must answer more than one question from any one section, he is advised not to attempt more than the time will admit of his completing, since little or no credit will be given for incomplete or inaccurate constructions.

I.

Construct a triangle from either of the following conditions:—

1. Its sides as 2 : 2.5 : 3 and circumscribing a circle of .75 inch radius.
2. Its sides in the same ratio but inscribed in a circle of 2 inches radius.
3. Isosceles, its sides touching two circles in contact of 1 and .5 inch radii.

II.

Construct a triangle from either of the following conditions:—

1. Its sides as 2 : 2.5 : 3, its area 4.5 square inches.
2. Equilateral, its area equal to a rectangle of 3 and 2 inches side.
3. Its base 3 inches, its vertical angle 40°, and its sides as 2 : 2.5.

III.

1. Inscribe a circle in a sector of 70° and 2.5 inches radius.

2. Describe a circle of 1.5 inches radius to touch a circle of 1 inch radius and a straight line 1 inch distant from this circumference.

3. Two concentric circles are 1 and 1.5 inches radii, draw a chord of the outer circle so that it may be divided into three equal segments by the circumference of the inner one.

IV.

1. Construct a quadrilateral A B C D, its sides A B = 2.5; B C = 3; A D = 4 inches, its diagonals at right angles, A C being 4 inches.

2. Construct a quadrilateral equal to the above in area, but its perimeter the least possible.

3. Construct a regular pentagon of 6 inches area.

V.

1. Three lines, each 3 inches long, meet in a point, each being at right angles to the other two; draw their plan when one is inclined at 25°, another at 50°.

2. Three indefinite planes are at right angles to each other and touch a sphere of 1 inch radius resting on the paper, one plane is inclined at 50°, another at 70°, show their intersections (or traces) with the paper, and mark the points in which they touch the sphere.

VI.

1. A square, of 2.5 inches side has its centre and two corners 3, 2.5; 3.5 inches above the paper; draw the plan of it and an elevation on a plane parallel to either diagonal.

2. Three corners A, B, C of a regular pentagon of 1.75 inch side are 1; 1.5; 2.5 inches above the paper, draw its plan and add an elevation on a plane parallel to the diagonal A C.

3. Draw the plan of a circle of 1.5 inch radius when two tangents to it which are at right angles are inclined at 30° and 40°.

VII.

A pyramid 4 inches high, has a regular pentagon of 1.5 inch side for its base, draw its plan when it is in one of the following positions:—

1. Lying on one face on the paper.
2. When the plane of one face is vertical.
3. When the planes of two faces are vertical.

VIII.

1. A cylinder 2.5 inches in diameter and 3 inches long, is terminated by a cone, 2 inches high, the two solids having a common axis, draw the plan of them when a straight line on the conical surface is either vertical or horizontal.

2. If the cylinder of the last question is cut by a plane making an angle of 70° with its axis, and passing through a point in the circumference of one end, draw the development of the surface cut off.

3. A sphere of 1.5 inch radius rests on the paper, and a cylinder of 2 inches radius also lies on the paper, and touches the sphere, draw their plan and mark the point of contact.

IX.

A box 28 inches long, 12 wide, and 9 inches deep in the clear, bottom and sides .75 inch thick, is divided into two by a cross partition, and one of these divisions is again divided into two equal parts, these partitions being .25 inch thick and their tops to be .75 below the upper edges of the sides and ends—

1. Show this box in isometrical projection to a scale of $\frac{1}{4}$.

2. Show it in perspective, the eye being 5 feet from one corner and 2 feet above the plane of the top, the plane of the picture touching one upright edge, but equally inclined to front and end.

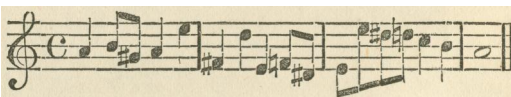
THEORY OF MUSIC.

THREE HOURS ALLOWED.

I. **RUDIMENTS OF MUSICAL GRAMMAR.**

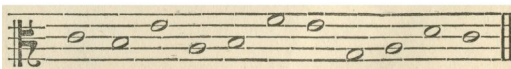
(Nos. 1 to 4 must be answered on music paper, and in the order in which they are put.)

1. Transpose the following a third higher.



2. Write the pluperfect fourth or tritone, in the scales of *Do* (C), *Re* (D), *Mi b* (Eb), *Fa* (F), *Sol* (G), and *La b* (Ab).

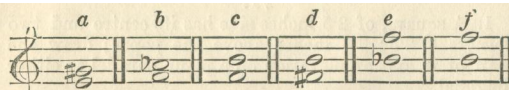
3. Write the following (at the same pitch) first on the treble, then on the bass, stave.



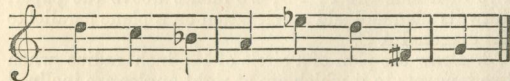
4. Write, from memory, any short tune, or passage of melody, with which you are acquainted.

5. How does the minor always differ from the major scale; and in what respects are the two sometimes alike?

6. Name the intervals formed by the following.



7. In what scale or key is the following?

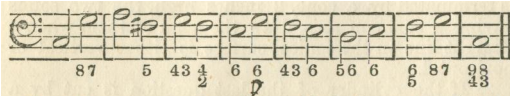


8. How do *a* and *b* differ? Give the time signature of each.

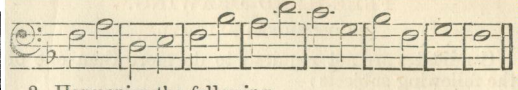


II. HARMONY, COUNTERPOINT, AND MUSICAL HISTORY.
(Nos. 1 to 3 must be answered on music paper, and in the order in which they are put.)

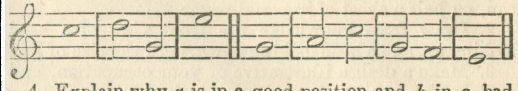
1. Add three parts to the following.



2. Add a part or parts, in any kind of counterpoint, to the following.



3. Harmonize the following.



4. Explain why *a* is in a good position and *b* in a bad one.



5. What is meant by a dissonant interval?

6. Give the rules for resolving a seventh, an imperfect fifth, and a ninth.

7. What notes of a scale are most often used as roots or fundamental basses?

8. Name the most distinguished composers of the modern German school, and state anything you know about their lives and works.